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PROFESSOR THOMAS HARRISON MONTGOMERY, JR.

THOMAS HARRISON MONTGOMERY, JR., was born in New York City March 5, 1873, and died in Philadelphia March 19, 1912. Within this brief span of years he accomplished much; by the strength and manliness of his character he exerted a deep influence on all who knew him, by the extent and value of his scientific work he has left a lasting impress on his chosen science of zoology. This biographical sketch has been prepared as a tribute to the memory of a friend and colleague and in the hope that a more intimate acquaintance with his life and work may be welcomed by all who knew him either in person or through his writings.

In inheritance and education Professor Montgomery was unusually favored; he came of a distinguished family and his environment and training were of the best. The Montgomery family came to America from Ayrshire and settled in New Jersey in 1701. Among the paternal ancestors of Professor Montgomery were many distinguished clergymen, lawyers and business men. One of his great-great-grandfathers was William White, "the first bishop of English consecration in the United States." Through his mother, Anna Morton, he was descended from a line of distinguished physicians and scientists; his grandfather, Dr. Samuel George Morton, was one of the founders of the modern science of anthropology and was president of the Academy of Natural Sciences of Philadelphia from 1849 to 1851. Professor Montgomery sometimes spoke of Dr. Morton in a way which indicated that he had been deeply

influenced by the example of his life and work.

His father, Thomas Harrison Montgomery, was president of the Insurance Company of North America from 1882 until his death in 1905. He was a gentleman of unusual culture and ability, deeply interested in the work of churches, charitable organizations and educational institutions, and the author of several publications on genealogical and historical subjects, among which the most notable was a book of nearly six hundred pages entitled "A History of the University of Pennsylvania from its Foundation to A.D. 1770." In recognition of his scholarly ability the University of Pennsylvania conferred upon him the honorary degree of Litt.D. He had a large family, six sons and three daughters, and his influence over his children and their admiration for him deeply impressed all who came into their family circle. Professor Montgomery summed up his "Memoir" of his father in these words:

> One can paint certain traits of this large and rich character, but it is difficult to make a just portrait. A man of virile and broad mind, of very catholic tastes; a respecter of knowledge and a contributor to it; true and generous to all; with unimpeached personal honor; self-deprecatory but always compelling respect; ever active in work and economical of time, striving to do his best; a wise and tender husband and father, and a noble Christian gentleman. A man of religion that has no harshness but is filled with sweetness and hope and charity.

In his education and environment Montgomery was no less favored than in his inheritance. When he was nine years old his father removed to the country near West Chester, Pa., and here his real education began in the fields and woods about his country home. It was particularly in the study of birds that the mind of this naturalist was formed and moulded. Not later than his twelfth year he began to make a systematic study of the birds found in the vicinity of his home and by the time he was fifteen he had a collection of about 250 bird skins, and a record of each specimen giving the date and locality, food, measurements, and, under "remarks," many observations on anatomical and ecological features. By the time he was seventeen his collection had grown to about 450 bird skins, and his observations entered in his notebooks form many pages, perhaps volumes,[1] of interesting and discriminating observations on the migrations, habitats, breeding and nesting habits, food and methods of getting it, care of young, songs and notes, and many other details of the life of birds. Other notebooks contain detailed drawings of dissections, skeletons and general anatomical features. Intermingled with these observations on birds are many expressions of delight in the beauties of nature, in the splendor of the woods in winter, the joys of an early summer morning, the majesty of a thunderstorm, etc.

His formal schooling began at Dr. Worrall's School in West Chester; afterwards he attended the Episcopal Academy in Philadelphia, where he graduated at the age of sixteen. In the fall of 1889 he entered the University of Pennsylvania and continued there until the end of his sophomore year. While at the university his only biological work was a course of lectures by Cope on recent and fossil vertebrates which gave him a deep and lasting interest in comparative anatomy and paleontology. Supplementary to his work at the University he spent much time at the Academy of Natural Sciences of Philadelphia, studying in the museums and library, and there he developed that omnivorous

[1] The earliest notebook I have seen is headed "Note Book No. 5," and dates from his seventeenth year.

taste for all kinds of zoological literature which was one of his strong characteristics. He once said to the writer that while he was at Berlin he read the whole series of the Naples *Jahresberichte,* and as his memory was unusually retentive he soon acquired a very broad acquaintance with the literature of his science.

In the summer of 1891 he accompanied his father on a trip to Europe, and, fascinated by the possibilities for the study of anatomy and zoology in Germany, he persuaded his father to allow him to stay there for the remainder of his university course. He entered the University of Berlin in the autumn of that year, devoting attention particularly to human anatomy and morphological zoology. He applied himself with great energy and enthusiasm to his work and matured very rapidly as a student and investigator. It had been his intention to go to Leipzig for a portion of his university course, but his work in Berlin kept him so busy and so satisfied that he remained there for three years, taking the degree of Ph.D. in 1894, when he was but twenty-one years old. His preceptors in Berlin were Waldeyer, O. Hertwig, F. E. Schulze, Schwendener, Möbius, Dames, Heider, Korschelt and Jaeckel. He prepared his thesis under the direction chiefly of Schulze. Student associates at Berlin whom he often mentioned and who left a deep impress upon him were Fritz Schaudinn, afterward famous for his study of pathogenic protozoa, and F. Purcell, at present director of the Capetown Museum, South Africa.

As indicative of the strong hold which studies of evolution had made upon him may be mentioned the three theses which he defended on the occasion of taking his degree: "I. Für die Phylogenie ist das Studium des Nervensystemes von der grössten Wichtigkeit." "II. Die Nächsten jetzt lebenden Verwandten des *Limulus* sind die Arachnoiden." "III. Vogelarten, die periodisch lange Wanderungen durchmachen, haben keine geographischen Varietäten."

Whereas his earlier studies had been devoted largely to birds, his work at Berlin was chiefly on other classes of animals. His inaugural dissertation was an anatomical and histological description of a new genus and species of nemertean worm found at Berlin, and this was the first of a series of ten papers which he wrote on this group of animals. However, his interest in ornithology did not flag, and in several letters to Witmer Stone he expresses his great interest in the work of the American Ornithological Union, of which he had been elected a member, and his regret that he was unable because of the pressure of other work to continue his study of birds while abroad. Just before he took his degree he wrote to Mr. Stone:

> I have done absolutely no ornithological work in Germany, and will probably never have the time for it in the future. I have been studying especially comparative anatomy and embryology, but I have not yet lost my little taste for collecting and general field work, though that is now for me simply a happy bygone.

Nevertheless, after his return from Germany he continued for some time to record his observations on birds in his "Ornithological Field Notes," and he later published five papers based largely on these observations; up to the time of his death his interest in birds and in general field work never waned.

He returned to this country early in 1895 and for the next three years occupied a research room at the Wistar Institute of Anatomy in Philadelphia, where he continued to work unremittingly at his researches. During the summer of 1895 he studied in the laboratory of Alexander Agassiz at Newport and at the U. S. Fish

Commission Station at Woods Hole. In the summer of 1896 he worked for a while at the marine laboratory of the University of Pennsylvania at Sea Isle City, N. J. The summer of 1897 he spent at the Marine Biological Laboratory, Woods Hole, and thereafter nearly every summer of his life was spent there, except for four summers, when he was in Texas.

In 1897 he was appointed lecturer in zoology at the University of Pennsylvania; in 1898 he was advanced to an instructorship and in 1900 to an assistant professorship. During the years 1898 to 1903 he was also professor of biology and director of the museum in the Wagner Free Institute of Science in Philadelphia. In 1903 he was called to the professorship of zoology in the University of Texas, where he remained until 1908, when he became professor of zoology and head of that department at the University of Pennsylvania, and in this position he continued until his death in 1912.

He was a trustee of the Marine Biological Laboratory and clerk of the corporation of that institution from 1908 until his death, and during the same period he was co-editor of the *Journal of Morphology*. He was a member of the American Association for the Advancement of Science, the American Society of Naturalists, the American Society of Zoologists, of which he was president in 1910, the American Philosophical Society, the Academy of Natural Sciences of Philadelphia and the Texas Academy of Sciences, of which he was president in 1905.

This bare catalogue of the positions of responsibility and honor which he held indicates how rapidly he rose to prominence in his science, but it does not indicate the means by which he achieved distinction. It remains to describe his unusual qualities as an investigator, as a teacher and organizer, and as a man.

He was an unusually active investigator in many fields, and a ready and prolific writer. His life as an author extended only from 1894 to 1912, eighteen years in all, but in that time he made many valuable contributions to science and published one large book and more than eighty papers. His breadth of view and of sympathy is indicated by the numerous branches of zoology to which he contributed. Sixteen of his papers were devoted primarily to taxonomy, five to distribution, eleven to ecology and behavior, sixteen to morphology, twenty-five to cytology, eight to phylogeny and one to experiment. He had just begun on experimental work during his last year, and there is no doubt that he would have contributed largely to this branch of zoology had he lived. His breadth of view is shown also if one considers the groups of animals studied. His earliest publications dealt with nemertean worms, on which he wrote ten papers; his observations on birds are given in five papers, and those on other vertebrates in two; he published ten papers on hairworms, two on rotifers, fourteen on spiders, three on insects, twenty-five on cytology, of which fifteen dealt with insects alone, and sixteen on phylogeny and general topics (see bibliography).

Most of this work was very good and some of it was remarkable for its influence. Among his most important contributions must be mentioned particularly his various papers on the habits of spiders (Nos. 31, 37, 38, 41, 42); his studies on the nucleolus (Nos. 47, 48, 50); and his extensive studies on spermatogenesis (Nos. 49, 51–71). In the latter field a discovery of really epoch-making importance was his observation of the conjugation of separate chromosomes in preparation for the maturation divisions, and his clearly reasoned conclusion that one chromosome of each pair is of paternal and the other of maternal origin.

Another discovery of the utmost importance was that in certain Hemiptera an odd number of chromosomes may be present in the divisions of the spermatocytes, but he just missed the discovery that this phenomenon is associated with the determination of sex, though after this discovery was made by McClung, Stevens and Wilson, his later work did much to confirm it. His discrimination of the different kinds of chromosomes and his terminology for these (62) has been widely accepted and now forms part of the science of cytology. His studies on nucleoli, particularly his great work on the morphology of the nucleolus (48), contain a wealth of observations on these structures in a great number of animals, and this work did much to establish the conclusion that the nucleolus is a relatively unimportant part of the nucleus. When he had reached this conclusion he turned his attention at once, and with characteristic directness, to those parts of the cell which he considered most important, viz., the chromosomes.

It was in studies of natural history and general zoology that he took greatest delight and his work in these lines was particularly valuable. His early training gave him a fondness for, and facility in, taxonomic and faunistic work. He described many new species of nemerteans, hairworms, rotifers and spiders; he made faunistic lists of these animals as well as of birds and certain insects; he loved museum work and had the systematist's veneration for "type specimens." But his taxonomic work was much more than a bare description of species; it usually involved a thorough study of the anatomy and histology of the forms described, and to this he added, whenever possible, a study of their life histories and habits. He maintained that taxonomy of the right sort was one of the most inclusive and fundamental branches of zoology, since it involved practically all other branches of the science.

His studies on the behavior of animals are especially important. With great patience and enthusiasm he would spend days and nights studying the habits of different animals. His observations on the feeding habits of owls (13) are a model of their kind, and his studies of the habits of spiders (31, 37, 38, 41, 42) are worthy of the great masters of natural history, whose best works they recall.

He was a naturalist before he was a laboratory scientist, and he looked forward to the time when he could direct all his researches to the study of spiders as Wheeler had done for ants. The character and methods of his work were his own and in many instances can be traced back to his early training as a naturalist. He allowed no one to bring him "material" for study; indeed, the animals he studied were never mere "material" to him, but he did his own collecting. To all his friends the many newly turned stones in the fields about Woods Hole were a sign that Montgomery had been collecting there.

Although he held tenaciously to the value of the old zoology, he was quick to grasp the importance of work in new fields and bold and independent in entering them and in reaping their harvests. This applies especially to his work in cytology, for which he had made no special preparation, but in which he probably achieved his greatest successes. He clearly distinguished large problems from small ones, and he went straight to the center of each. He was keen in seeing the theoretical significance of his observations, and critical but just in estimating the value of the work of others. He was peculiarly independent in his work and was not in the habit of discussing it with others nor of asking advice, and it often happened that

even his intimate friends did not know his conclusions on important matters until after they had appeared in print.

He was primarily a naturalist and had no patience with experimental work done by men who had no intimate acquaintance with the animals studied; he characterized such experimentalists as "Versuchstiere," and hated their so-called "problems." Later he came to be an enthusiastic advocate of the experimental method as a supplement to, but not as a substitute for, observational studies, and in his new laboratory he had made extensive provision for such work.

He was a very rapid worker, and as he wrote up his results at once and published them without delay he always had several papers in press, and at his death it was found that he had left but little work unfinished. One notable exception is a textbook of cytology for which he had completed eleven chapters, leaving the rest of it in outline. It is to be hoped that this valuable work will be completed and published. In it he manifests that unusual mastery of the literature of the subject which was one of his leading characteristics, and which particularly fitted him for such a task.

As a teacher and organizer he was successful in a rare degree. His enthusiasm was balanced by critical judgment, and he was an inspiring and exacting teacher. His intimate acquaintance with the materials and literature of zoology, his positive and clear-cut opinions on most subjects, a sense of humor and a certain picturesqueness of language made him a most instructive and entertaining lecturer; also he had marked ability to direct and stimulate graduate students in research work. His plans for the development of zoology at the University of Pennsylvania were very comprehensive, including almost every great branch of the science.

During the last three or four years of his life, his greatest work was the new zoological laboratory at the University of Pennsylvania, which will ever be a monument to his energy, ability and foresight. He and his colleagues worked on the plans almost a year, and all details of construction, equipment and furniture were carefully planned. Almost another year was spent in constructing the building, and the labor of moving into it and getting things into working order had scarcely been finished when he was stricken with his last illness. He deeply regretted the loss of time from his researches which the construction of the building involved, but as the plans and building were completed rapidly, this lost time was reduced to a minimum, and he expected to enjoy for many years the facilities which he had so laboriously secured.

Although he often spoke of the time lost from his researches while the building was on hand, it is nevertheless a fact that during those years he published almost as many papers as during any previous period of equal length, while the number of papers published during the last year of his life was as great as in any other year, with a single exception. He realized that the new laboratory must be justified by the research work done in it, and the responsibility of "making good" rested heavily upon him. Undoubtedly during those last few years he worked beyond his strength, and when the fatal disease attacked him he had not resistance enough to overcome it.

He was stricken with pneumonia on February 15, 1912, and after a long struggle, in which hope many times alternated with despair, he succumbed on March 19, only a few days after his thirty-ninth birthday. His death, which occurred on the opening day of the celebration of the centenary of the Academy of Natural Sci-

ences of Philadelphia, cast a shadow over that event. From boyhood days his interest in the Academy had been keen and he had taken an active part in the preparations for the centennial celebration and had contributed an important paper on "Human Spermatogenesis" for the commemoration volume of the *Journal* of the Academy; this paper, which was his last contribution to science, appeared as the first article in the commemoration volume, which was issued some time after his death. His funeral was attended by many people from a distance, who had been present at the Academy's Centennial, as well as by his colleagues and students. His body was borne by his family and a few intimate friends to its last resting place on a hill overlooking the beautiful Schuylkill Valley and the great city with which his life had been so intimately identified.

His influence on science has reached many who never knew him and will last long after his personality is forgotten, and yet it is as the person, the man of honor and fidelity, of high ideals and courage and courtesy, that his friends love to remember him.

In person he was unusually tall and slender, with a serious but kindly face, and his general appearance gave the impression of great vigor of mind and will rather than of body. He was, however, capable of great physical endurance and was rarely ill. He matured early and appeared older than he really was and this appearance was strengthened by the way in which he regarded himself.

In 1901 he married Priscilla, daughter of John and Elizabeth Braislin, of Crosswicks, N. J. To them were born three sons, Thomas, Hugh and Raymond, and the pleasure which he took in the society of his wife and boys, and his devotion to them, demonstrated that he was a man of affection as well as of intellect, a loving husband and father as well as a distinguished scientist.

In his ornithological notebooks he has revealed his heart as in no other of his writings. Intermingled with the observations which he records are many passages evidently intended only for his own eye, and it seems almost like intruding into private matters to make them public, and yet they reveal so fully his inner motives and the philosophy of his life that it seems to the writer that the sketch which has here been drawn would be sadly incomplete without some reference to them. Under date of September 22, 1898, he gives a list of the summer birds still to be seen near his country home, and then after some comments on the beauties of the changing seasons, writes some ten pages on what might very properly be called the religion of a naturalist. Unfortunately limits of space do not permit the publication in full of this passage, but the following extracts are taken from it:

> In the make-up of the naturalist belongs as much appreciative interest as keen perceptive ability. In a word the naturalist must feel himself at one with nature. . . . The faintly heard note of a bird, the first odor of spring in the air, the moaning of wind in the spruces, or the wondrous insect humming on an August night—these are what set a train of vague but deliciously keen memories and longings in motion—a mental state which is the purest and most spiritual. Whoever has a true and tender love for the natural may experience at least the unexplained joy produced by such yearnings. . . . Such yearnings are the sublime in the experience of the naturalist. . . .
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> To me there are memories more precious than all others, memories of elated mental states associated with enthusiastic appreciation of the natural. . . . Analysis of such states may be possible, but shall one tear apart the web of his best dreams? . . .
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> What is the basis of such longings? Many would regard them as trivial or foolish, but the many are not naturalists. I recall with startling vividness when as a small boy I first heard the cat-bird's song in Central Park, New York City;

that was the first song that ever stirred me, but it left a yearning ineradicable as long as the mind lasts. Another time on the top of a small oak tree, on a bitterly cold winter day, I saw a pine finch, the only morsel of living nature in sight; the peculiar happiness of that moment will never be forgotten. The mating note of the red-winged blackbird, when it first arrives in the spring, or the tremulous note of the white-throated sparrow; at twilight the rich variety of notes of the screech owl; cold nights on the coast of Maine with the plover lined along the shore; or titmice in the pine forests of Germany;—such associations and innumerable others, appear to the memory time and time again, . . . and they are always an unexplained joy.

Perhaps such associations are hallowed merely in comparison with the tedium of life's little cares. This is very probably the case, but it in no wise lessens the joy. Man must work, he is paid by the work rather than by the hire, and his enjoyment is found in his work. But far above the plane of such enjoyment is the wonderful ecstasy produced by yearnings whose object is unknown. In human nature the wonderful thing is the multiplicity of characters, and the infinite number of changes and moods in each character. One of these is the character of the poet and naturalist. A naturalist may not be "born" one, for this is a loose expression. But he must become one in his earliest, purest and most impressionable years; let a few years go by, and the clay is too hard for the mould. Once a naturalist always a naturalist, the zeal of a naturalist never dies, but he must not be fettered in his pursuits. The cravings of which we have spoken are the poetic, spiritual side of the naturalist—the naturalist in contradiction to the *Naturforscher*. . . . One may become an excellent morphologist or physiologist, a clear elucidator of phenomena, and yet be without any poetic spirit. Or one may derive his most hallowed impressions from presentations in the laboratory, while another gets them from observation of objects in the field. One can only postulate that for certain natures vague naturalistic sensations are productive of the greatest joy. I too can testify to the keen joy experienced when after months of toil and many failures one attains the solution of a difficult problem. But in my case such a joy does not make as lasting an impression as does the pleasure from the mental states spoken of above; and surely the strength of a joy may be measured by the length of its duration.

He loved to spend many hours alone in fields and woods observing living creatures and feeling himself to be "a modest but integral part of nature" and yet he was not a mystic nor a recluse, but a jovial and delightful comrade who took great pleasure in association with intimate friends. He had a fund of dry humor with which he lightened up serious subjects of conversation and yet on such occasions he never let himself go beyond proper and dignified bounds. He was a firm friend and a good hater—a man who was reserved and strenuous, but tender and sympathetic; and above all one whose chief motive in life was an absolute devotion to truth. His great will power was one of his most striking characteristics. His ability to concentrate all his energies upon his work was remarkable; at such times nothing diverted him and he allowed himself no relaxation. His powers of self-control in all personal relations were equally remarkable; although his nature was intense he was always master of himself. He was a strong and virile man—and yet he was not domineering nor self-willed and he preserved an exquisite balance between self-contained dignity and charming courtesy toward others. He was always kind and sympathetic, and it was from real kindliness of nature, as well as from good breeding that those qualities arose which to many of his friends seemed to entitle him in a peculiar degree to "the grand old name of gentleman."

He was for a few years consciously and joyously a part of that nature which he so much loved. He has left to men the record of a life devoted to science and enlightenment, and to his family and friends the memory of a true and noble soul.

Edwin G. Conklin

Forecast of the Birmingham Meeting of the British Association[1]

The meeting of the British Association for the Advancement of Science, which will

[1] From the London *Times*.

open in Birmingham on September 10, will be the fifth meeting which the association has held in the metropolis of the Midlands. The first Birmingham meeting was as far back as 1839, nine years after the association was established; the Rev. W. Vernon Harcourt, F.R.S., was president, and the attendance numbered 1,438. At the second Birmingham meeting, ten years later, when the Rev. Dr. T. R. Robinson, F.R.S., was president, the attendance sank to 1,071, one of the smallest musters in the history of the association; but at the third meeting, in 1865, when Professor J. Phillips, F.R.S., was president, the attendances totalled 1,997. The last meeting held in Birmingham was in 1886, two years after the association had paid the first of its visits to the overseas empire at the invitation of the city of Montreal. As an acknowledgment of the hospitality then shown to the association, as well as of the high standard of scientific attainment in Canada, the president of the Birmingham meeting in 1886 was Sir J. William Dawson, F.R.S., principal and vice-chancellor of McGill University. Both in point of numbers and as regards the scientific interest of the proceedings, the meeting was one of the most successful in the long record of the association. The attendance numbered 2,453, and among the sectional presidents were Professor (afterwards Sir) George Darwin, F.R.S., Mr. (afterwards Sir) W. Crookes, F.R.S., Professor T. G. Bonney, F.R.S., and Major-General Sir F. J. Goldsmid.

Hopes are entertained that the forthcoming meeting will be the largest of all the Birmingham meetings. There are expectations of an attendance of over 3,000, and the program of the meeting, both on its scientific and social sides, is certainly one of a very attractive order. Appropriately enough, Sir Oliver Lodge will assume the presidential chair at the inaugural meeting. By conservative men of science the principal of Birmingham University is regarded as decidedly heterodox in some of his views; but he has the courage of his convictions, and is not afraid, when grappling with problems of supreme human interest, to take a wide view of the scope of scientific research. How far he will allow himself to go in this direction in his presidential address is not known, but the subject of it, so far as yet defined, offers numerous possibilities, and the address is certain to be awaited with a good deal of curiosity. At present Sir Oliver Lodge's idea is to take a wide and philosophical survey of the position of science in general, incidentally dealing with the discussions and controversies relating to the existence and the functions of the ether of space, and to the physical continuity of which it is the chief element.

ACCOMMODATION AND ENTERTAINMENTS

Birmingham is excellently fitted to accommodate the largest congresses, even when they attain the size and complexity of the British Parliament of Science. The twelve sections composing the association will be much less scattered than in many cities in which meetings have been held. No fewer than seven of the sections will be grouped in one of the university buildings, Mason College. Excellent quarters have been found for the other sections in Queen's College, the Midland Institute, the Technical School and the Temperance Hall. The Town Hall has been allotted for the use of the association as a general reception room, and in the new Art Gallery of the Council House the Lord Mayor will hold a reception on the evening of Thursday, September 11. On the afternoon of the same day the university will confer honorary degrees on some of the most distinguished visitors, the ceremony taking

place in the new university buildings. Besides British men of science a considerable number of foreign men of science are expected to be present, among others who have accepted invitations being Professor Svante Arrhenius, of Stockholm, M. Lallemand, Professor Keibel, Professor Reinke and Professor Pringsheim. As usual, there will be various garden parties and other social functions for the entertainment of the visitors, as well as excursions on the Saturday to places within easy reach of Birmingham, including Stratford-on-Avon, Kenilworth, Worcester, Malvern and the Forest of Arden. A novel feature has been introduced into the program of entertainments in the shape of special performances at the Prince of Wales's Theater (opera), the Repertory Theater (modern drama) and the Kinemacolor Theater.

These festivities, of course, will be merely incidental to the serious work of the meeting, a permanent and valuable memento of which will be the handbook to the Birmingham district which is being prepared under the editorship of Dr. Auden. Mr. Neville Chamberlain is contributing to this handbook a section on town-planning, and a new and ingenious series of maps is being prepared for it under the direction of Professor Lapworth, F.R.S. Two evening discourses will be delivered on Friday, September 12, and Tuesday, September 16, the lecturer on the first occasion being Sir Henry H. Cunynghame, K.C.B., who will take for his subject "Explosions in Mines and the Means of preventing them"; while the lecturer on the second occasion will be Dr. A. Smith Woodward, F.R.S., who will treat of "Missing Links among Extinct Animals." Five lectures have been arranged by the council at the Digbeth Institute for citizens who are not members of the association. The first of these, "The Decorative Art of Savages," will be given by Dr. A. C. Haddon, F.R.S., on Thursday, September 11, at 8 P.M. Other lectures will be "The Panama Canal," by Dr. Vaughan Cornish; "Heredity in Relation to Man," by Dr. Leonard Doncaster; "The Microscopic Structure of Metals," by Dr. W. Rosenhain, and "Radio-activity," by Dr. F. Soddy, F.R.S. For the following particulars of the sectional proceedings we are indebted to the sectional presidents and recorders.

THE WORK OF THE SECTIONS

Section A (Mathematical and Physical Science) will have for its president Dr. H. F. Baker, F.R.S. He will probably speak of the relations of pure mathematics to the ordinary activities of life, trying to indicate what seem to him the justifications of a serious study of the subject, and thence proceeding to an attempt to set before those who have some mathematical knowledge an idea of the extent and present promise of the subject, by referring to some of the leading problems and their interconnection. During the week of the meeting the section will engage in several important discussions. Professor A. E. H. Love, Professor E. Rutherford and Professor Pringsheim have promised contributions to a discussion on radiation; mathematical geography will be the subject of a joint discussion with the geographical section; the investigation of complex stress distribution will be discussed with the engineering section; and there will also be a discussion on non-Euclidean geometry. Among individual papers one on lightning and protection from it will be presented by Sir J. Larmor, another on atmospheric pollution has been promised by Dr. J. S. Owens, while the dynamics of evolution will be discussed by Mr. A. J. Lotka.

The president of Section B (Chemistry)

will be Professor W. Palmer Wynne, F.R.S. His address will deal mainly with some problems and aspects of organic chemistry. A subject of national importance which will be discussed by the section is the economical use of coal and fuels derived therefrom. Among others who are expected to take part in the discussion are Professor Armstrong, Dr. Beilby, Professor Bone, Dr. Wheeler, Dr. M. G. Christie, Dr. Colman, Mr. J. H. Yates, Mr. J. Bond and Mr. R. Threlfall. The discussion will cover gas producers and the use of gas, coking and by-product recovery from small coal, gas fires and their efficiency. Other discussions have been arranged on radio-active elements and a periodic law, to be opened by Professor F. Soddy, and the significance of optical properties. Several metallurgical papers will be presented to the section, including one by Professor E. Cohen, of Utrecht, on strain diseases in metals.

Professor Edmund J. Garwood will preside over Section C (Geology), and in his address will probably touch on the conditions under which certain sedimentary rocks were deposited, especially those laid down during lower carboniferous times. A large number of papers have been promised for the section, among them one by Mr. V. C. Illing on recent discoveries in the Stockingford Shales, near Nuneaton, and another by Mr. F. G. Meacham on the probable development of the South Staffordshire coalfields to the west of the Western Boundary Fault and to the Shropshire Fault and the Severn Valley Fault, with some notes on the probable conditions of mining in the new area. The district round Birmingham offers exceptionally good opportunities for geological excursions, and these will be made the great feature of the sectional proceedings. While the mornings will be given up to the reading of papers, the afternoons will be given up to short excursions, and at the close of the meeting there will be a three-days' excursion into Shropshire. The organization of these excursions is in the hands of perhaps the greatest authority on all this country, Professor Charles Lapworth, F.R.S. As an introduction to the excursions Professor Lapworth will address the section on the geology of the country round Birmingham immediately after Professor Garwood's presidential address.

Section D (Zoology) will be presided over by Dr. H. F. Gadow, F.R.S., who, in addition to his presidential address, will open a discussion on convergence in the mammalia. A subject of vital importance to the development of tropical Africa will be dealt with by Professor E. A. Minchin in a lecture on some aspects of the sleeping sickness problem. Among the papers promised are one by Dr. F. A. Dixey on the geographical relations of mimicry, and another by Mr. W. Bowater on heredity of melanism in lepidoptera. A discussion on mimicry will be opened by Professor E. B. Poulton. During the week a visit will be paid to the Burbage Experimental Station, by invitation of Major Hurst, to view the results of inheritance experiments. An important discussion, which will be held jointly with the physiological and botanical sections, will be opened by Professor B. Moore, F.R.S., on the subject of the synthesis of organic matter by inorganic colloids in the presence of sunlight, considered in relation to the origin of life.

GEOGRAPHY AND SOCIAL QUESTIONS

The professor of geography in University College, Reading, Dr. H. N. Dickson, will preside over Section E (Geography). His address will concern itself with the increasing recognition of the importance of human geography in the study of social and economic questions. Besides the joint

discussion with Section A on mathematical geography, there will be a discussion on the natural regions of the world, to be opened by Professor A. J. Herbertson, of Oxford University. In connection with the former subject the work of the Ordnance Survey, which has lately been submitted to some severe tests, will come under consideration, and a paper of special interest will be one by Captain H. Winterbotham on the accuracy of the principal triangulation of Great Britain. Most of the papers at present promised relate to questions of home geography, but Professor J. W. Gregory will deliver a lecture on Australia and Mr. I. N. Dracopoli will give an account of his recent travels in Jubaland, British East Africa.

The Rev. P. H. Wicksteed, M.A., who will preside over Section F (Economic Science and Statistics), intends to deal in his address with the simplifications in the teaching of political economy which appear to him to follow naturally from the acceptance of the Jevonian, or marginal, theory of distribution, and a frank abandonment of the cost-of-production theory of value. He will point out the confusion which has arisen from the ambiguous use of the term "marginal"—sometimes to signify the least favorable conditions under which an industry is pursued or the least efficient individual who pursues it, and sometimes to signify the dependence of the exchange value of any one of a group of indistinguishable individuals upon the contraction or expansion of their number. An attempt will be made to show that many of the categories and distinctions which still hold a prominent place in the text-books—such as the special laws of rent, interest, and wages, the treatment of buyers and sellers as opposed groups, the conception of increasing and diminishing returns as rival principles that divide the field of industry between them—should either be abandoned or reduced to a secondary position. No attempt will be made to introduce any new principles, or to defend the "marginal" theory against actual or possible attack; Mr. Wicksteed will simply endeavor to develop the modifications in the methods of teaching and systematic exposition which, in his opinion, follow upon adoption of the theory.

The chief subjects which will come under consideration in the subsequent proceedings of the section are the cost of living, inland waterways, and trade unions in relation to profit-sharing and co-partnership. The discussion on the second of these subjects promises to be specially interesting. Lord Shuttleworth and Sir J. P. Griffith are among those who have promised to read papers, while Mr. Neville Chamberlain and Sir J. Brunner are among those who are expected to speak on the subject. A paper by Professor S. J. Chapman will deal with progressive taxation, and Professor A. W. Kirkaldy will consider the economic effects of the opening of the Panama Canal. Professor A. L. Bowley will contribute to the discussion on the cost of living a paper on the relation between wholesale and retail prices, with special reference to working-class expenditure, and Mr. Cuthbertson will contribute a paper on working men's budgets.

ELECTRIC RAILWAYS AND WIRELESS SIGNALS

In Section G (Engineering) the presidential chair will be occupied by Professor Gisbert Kapp. His address will deal with the electrification of main lines of railway. The treatment will be non-mathematical, and will be theoretical only in so far as it is necessary to develop certain features on a scientific basis. In the main the address will be a statement of what has actually been accomplished in this country and on the continent, including technical details

of lines and electromotives, tables of weights, speeds, acceleration, etc. The electromotives of the Loetschberg Tunnel line just opened will be among those dealt with in the address. The committee on gaseous explosions will present its report during the meeting, and among many individual contributors to the proceedings will be Professor Marchant with a paper on some effects of atmospheric conditions on wireless signals; Professor Howe, who will discuss the nature of the electro-magnetic rays employed in radio-telegraphy and the mode of their propagation; Mr. F. W. Lanchester, who will deal with the internal-combustion engine as applied to railway locomotives and will also have something to say about aeronautics; and Professor Burstall, who has promised a paper on solid, liquid and gaseous fuel.

The administrative value of anthropology will be the subject of Sir Richard Temple's presidential address to Section H (Anthropology). He proposes first to explain the nature and scope of the science as at present understood, the mental equipment necessary for the useful pursuit of it, and the methods by which it can be successfully studied. Next he proposes to deal with the extent and nature of the British Empire, the kind of knowledge of the alien populations within its boundaries required by persons of British origin who would administer the empire with benefit to the people dwelling in it, and the importance to such persons of acquiring that knowledge. Lastly he proposes to note the steps taken or suggested by the Royal Anthropological Institute and the universities of Cambridge and Oxford towards the supply of the knowledge of mankind necessary for sound imperial administration, which, to his mind, is the practical result of the studies of anthropologists. The programme of papers to be submitted to the section includes communications from Dr. H. R. Rivers on sun cult and megaliths in Oceania, and from Dr. Landtman on the ideas of the Kiwai Papuans regarding the soul. A contribution with an important bearing on the history of human sacrifice will be a description by Mr. J. H. Powell of the ceremony of hook-swinging in India, with lantern illustrations. The influence of geographical environment on religious development in northern Asia will be the subject of consideration by Miss Czaplicka, while Major Tremearne will deal with the magic of the Nigerian Hausas.

ARCHEOLOGY AND PHYSIOLOGY

British archeology will be well represented, as also will the results of archeological research in other parts of the world. Dr. Capitan, of Paris, who will be among the foreign guests, will describe paleolithic paintings recently discovered in the south of France; Professor Flinders Petrie will describe the results of his last season's work; and Dr. T. Ashby, of the British School at Rome, will present a report on a recent examination of the archeological remains in connection with the Appian Way and some fresh material bearing on the system of aqueducts in Rome. A paper of great importance as an example of the statistical method will be presented by Professor H. G. Fleure and Mr. T. C. James, dealing with the physical characters of the people of Wales and the borders.

The president of Section I (Physiology) will be Dr. F. Gowland Hopkins, F.R.S. During the meeting the section will receive the report of its committee on anæsthetics, in connection with which Sir Frederic Hewitt will speak on the subject of the state regulations of anæsthetics. The feature of the proceedings will be the number of joint meetings with other sections, demonstrating the close relation between dif-

ferent branches of science. There will be a meeting with the agricultural section to discuss the physiology of reproduction, with special reference to the factors affecting fertility and sterility in livestock. Reference has already been made to the joint meeting with the zoological and botanical sections. It is hoped to arrange a joint meeting with the chemical section for a discussion on fermentation. Finally the subsection of Psychology will hold a joint meeting with the Educationists. In individual papers Mr. W. McDougall will discuss the theory of laughter; Miss M. Smith and Mr. McDougall will communicate a paper on memory and habit; Dr. J. L. McIntyre will discuss the effects of practise on the memory of school children; Mr. Stanley Wyatt will report the results of some investigations into the reliability of children's testimony; and Mr. T. H. Pear will report on recent experiments regarding the psychology of testimony.

Section K (Botany) will present the rare, if not the unique, spectacle in the history of the association of being presided over by a lady. In her address to the section Miss Ethel Sargant will deal with the subject of plant embryology, considering recent work on the subject and its bearing on various morphological problems. A semi-popular lecture will be delivered by Professor W. H. Land, F.R.S., on Epiphyllous Vegetation, and there will be a joint discussion with the agricultural section on problems in barley production. A joint meeting, as already stated, has been arranged with the zoologists and physiologists. Like the zoologists the botanists will engage in an excursion to the Burbage Experimental Station, and another excursion will be made to Sutton Park.

EDUCATIONAL SCIENCE

Principal E. H. Griffiths will preside over Section L (Educational Science). In preparing his address his object has been to make an inquiry as to the general feeling with regard to the success of our educational system, with special reference to primary education. He has collected the opinions of business men and teachers and has found the prevailing atmosphere to be one of pessimism. Venturing further afield he has made detailed inquiries of all the directors of education in the kingdom. Replies have been received from 112 directors, representative of every kind of authority in all parts of England and Wales. These replies are confidential, but they provide the basis for certain conclusions which will be set out in the address and which will, it is hoped, be found useful at a time like the present, when it seems as though our educational system is in the melting pot. Principal Griffiths will urge in his address that we are making the mistake of over-estimating knowledge and under-estimating character; that it would be better if we could model our educational system more on the boy scout movement, that is, cultivate character and intelligence until the desire for knowledge is established. Touching briefly on matters connected with secondary and higher education, he will suggest that what we want is a more careful sifting of the products of the primary schools so as to ensure that only those who are really fitted to receive secondary education should be helped by the state to obtain it; that a more careful system of selection should be established, and that when the fittest have been found more generous help should be given when necessary. As regards the universities, the danger of their passing under state control will be pointed out.

As usual, the section will follow the wise practise of discussing a few subjects of large importance rather than receiving a

multitude of disconnected papers. As an outcome of suggestions made at the Dundee meeting the section will meet with the anthropologists to discuss the educational value of museums. A discussion on the function of the modern university in the state promises to be very attractive, as the heads of the newer universities, including Sir Oliver Lodge, have promised to take part. The president of Stanford University, Mr. Alfred Mosely and Miss Burstall, of the Manchester High School for Girls, are also expected to contribute to the discussion. The discussion arranged with the psychological subsection of Section I will be concerned with the general question of the need for research in education, and with the specific researches which have been made into the vexed subject of the psychology of spelling. Two other discussions will be concerned with manual work in education and the registration of schools. The importance of the latter question was brought out by a committee at the Dundee meeting, while the importance attached to manual training is shown by the new emphasis which is now being laid on it in educational practise.

Professor T. B. Wood will preside over Section M (Agriculture). In his address he proposes to review the results of twenty years' work in agricultural science, to point out the successes and failures, to discuss the reasons for success or failure, and to endeavor therefrom to make suggestions for the future. As already stated, the section will engage in joint discussions with the botanists (on barley culture) and the physiologists (on the physiology of reproduction). Communications will also be made to the section by Sir Richard Paget, on the possibilities of partnership between landlord and tenant; Professor Fraser Story, on German forestry methods; Dr. H. B. Hutchinson and Mr. K. McLellan, on the partial sterilization of soil by means of caustic lime; and Dr. Winifred E. Brenchley, on the weeds of arable land.

THE PRINCIPLE OF MENTAL TESTS

THE standpoint of applied psychology is implicit in the conception of mental tests. They represent a group of procedures, usually of simple technique, developed so that our knowledge of individual differences may, as Cattell puts it, be employed to guide human conduct. To justify themselves, they must earn their bread in terms of usefulness for the questions of life. In this respect they differ from the leisure-class problems of true psychological science, which are exalted above these vulgar necessities.

Two broad functions of psychological tests are distinguished. One is the measurement of changes in individuals under controlled differences in experimental conditions. The studies of Hollingworth on caffeine and of Winch on the effects of school work are among the recent examples of this type. Here the problem has usually been defined in the determination of central tendencies. To this limit, measurements can be made with comparative reliability, because the external conditions are well controllable, and the errors due to subjective factors tend, on the whole, to compensate. That is, a gain of 10 per cent. in the same individual for a second performance represents a gain of 10 per cent. in the same abilities as were concerned in the first performance. The more difficult question of just what these abilities represent in the individual case has been a secondary one for these studies, not usually coming into prominence.

It must be squarely faced, however, in the other function of psychological tests, that of measuring and interpreting the differences between individuals under similar immediate conditions. One may not say because Peter is 10 per cent. better in a memory test than Paul, that it is due to a 10 per cent. superiority in the same abilities as Paul's. It is not a difficult matter to construct tests in which consistent and certain individual differences ap-

pear. The quicksand begins at the next step; that of constructing tests which shall have a useful meaning. Individual differences in the tapping test are exquisitely clear through many aspects of the experiment; but what these individual differences represent in the personality of the subject we do not know. The problem of mental tests is duplex; to construct a test at once free from physical and physiological inaccuracies, and one that shall have a useful significance for the subject's adaptation to life. Without the first the second is unattainable; without the second the first is futile.

The questions of interpretation must not be taken too lightly. Psychological experiments of the present class must consistently represent those mental properties of the individual that it is desired to compare, properties such as it is useful to know about. The value of mental tests depends upon their correlation with the personality of the subject; and the essential task in the scientific development of any mental test is to determine how well it indicates some phase of the subject's personality.

Because it is much easier to do, we have been apt to develop handy psychological methods and then try to make them mean something, rather than to start from the things that are important to know, and trying to develop methods for determining them. But to start with the tapping test as a measure of voluntary motor ability, or with the A test as a measure of rate of perception, is too obviously approaching the problem at the wrong end. We must not be bound by the notion that one test tests one thing, another test another; one test usually tests several things, and it must take several tests to test one thing well. First must be known the direction our inquiries must take; a task whose extreme complexity demands analytical and systematic observation of human behavior, not to mention insight. Then one may seek to develop measures which shall be themselves reliable, and shall show the most constant relation to the elementary traits that are to be measured. The test is never an ultima ratio. If we want to determine how good a test the average daily wage is of the number of applicants for poor relief, we must have other, most reliable information of the number of such applicants. In the same way, in order to know how far any mental test is a reflection of personality, we must have accurate knowledge, from other experiential sources, of how this personality compares with others in the phase we may be testing.

Mental faculties differ a great deal in the completeness with which they are experimentally covered. Those mental tests are of the best assured value where the use made of the method is immediate so to speak in terms of its own result. Thus we may interpret a test of astigmatism in terms of its own result, because it represents a nearly constant attribute of the individual, unaffected by other uncontrolled factors. A test of color-blindness can be interpreted in terms of its own result, to decide on the fitness of the subject for railway or marine service. But this is not so much the case with the strength tests, such as are used in the gymnasiums. A person may test quite high on the dynamometers who can not make nearly so efficient use of his strength, or actually not be so strong, as one who can not make so good a record with them. Practical life puts the eyes to the same test that the Snellen types do, therefore they are a good test; it does not put the muscles to the same test that the dynamometers do, therefore they are an inferior test.

There is in our experimental literature a happily growing tendency, as exemplified in the work of Healy, G. G. Fernald, Simpson, and others, to submit the tests of the higher mental processes to the test of concrete experience. The most prominent result of this Fragestellung has been the series of graded tests. We wish to be able to say that a child has in certain ways the ability of an 8, 9 or 10 year old. Therefore we determine what degree of these abilities is actually characteristic of 8, 9 or 10 year old children. Just as, if we wished for a test of honesty, we should try to find some way in which persons known to be honest differed from persons known to be dis-

honest. Of course the child is ten years old only in those respects covered by the tests. And the striking results reported by Miss Weidensall at Cleveland illustrate that there are other mental factors, most important for adaptation to life, that are not reached even by the inclusive scope of the Binet tests.

This fundamental weakness, one which is shared very liberally with the remainder of mental tests, seems to be that they are too much concerned with processes that for want of better names we sum up under intellectual capacity and intelligence. External competence, not to speak of subjective balance, depends also upon the capacity to make the intellect effective in the vital activities. An important further obstacle to making it thus effective arises when accompanying feelings are such as to make the proper reactions in any way disagreeable or less agreeable than other reactions which are less objectively adequate.

It is difficult to estimate how much of the significance in our present mental tests may be lost through failure to attend to these factors. Three persons go through the number-checking test; one in 140 seconds, the other two in 100 seconds. But the check-marks of the first two are all made in consecutive order, at regular intervals, while the third works erratically, skips back and forth, marks now very fast, now very slow. Probably this subject differs from the second far more significantly than the second does from the first. Any one might have the highest intellectual standing. The regularity with which a voluntary task is performed, the attentional control over it, and its freedom from subjective interference is to my mind a far more important thing to observe than the absolute efficiency in some task but remotely connected with really vital reactions.

Yet most of our psychological tests pretend to measure maximal capacities of some sort, and this maximal capacity is taken to indicate the subject's essential response to the test. It is so in some simple tests, as those of the astigmatism type; but when the test is more complex, as the above-mentioned, gross efficiency is the product of many factors that are to be interpreted only on the basis of other, more analytical controls. This is only a part of the subject's whole reaction to the test, and is the less important part the less the test is related to the struggle for existence. In these tests it is not so important how much the subject does as what he does. The manner of dealing with the situation represents the more fundamental traits; four minutes of method with Healy's puzzle box is better than two minutes monkey-fashion. But because these factors are exceedingly difficult to describe and measure, the workers dealing with mental tests, who as a class are occupied with large masses of data gathered with relative perfunctoriness, are apt to pass them by.

The adequate interpretation of mental tests further requires that we understand their relation to the subject's emotional reactions. It is interesting to know that you can methodically take up Healy's puzzle-box and open it in fifty seconds; but it is far more important to know whether, if you were caught in Healy's puzzle-box, and expected your enemy at every moment, you would preserve the same effectiveness of your reactions towards it. In what ways and to what extent is affective sensibility manifested in the subject? How much does the effectiveness of a performance depend upon its position in the affective scale? How to measure this is what we are responsible for finding out; though I venture to predict that the answers, of which there will have to be many, will come not so much in terms of a capacity, like addition, or memory, as in terms of a tendency, like the individuality of free association responses, or the types in arrangements of relative position scales.

What has the author tried to do—how has he done it, and—is it worth doing? This is the framework on which we used to be told to construct a review. And so in reviewing the question of mental tests, it is endeavored to indicate that their proper task is the measurement of functions concerned in the mental adaptation to life, and how they can best perform it through giving a well-proportioned recognition to the intellectual, volitional and affective spheres. How much it is worth doing

is unwise to speculate on where it has been very inadequately done. The crucial question is if it will always be necessary, in order to correctly interpret our tests, to already know so much about our subject, that the test gives us no added information. To-day this is true in all the more complex mental processes; and it is not improbable that, as our tests are improved, a better understanding of human conduct at large will develop. This brings more into the foreground the quantitative features of experiment; to tell us something good to know more accurately than we could otherwise know it. It is the form and direction of the tests that has to be dealt with now. If we do not first interpret our tests by our subjects, we shall never understand our subjects through our tests.

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THE FOURTH INTERNATIONAL CONGRESS OF SCHOOL HYGIENE

As has been already announced the fourth international Congress of School Hygiene meets at Buffalo from August 26 to 30. The congress is under the patronage of the president of the United States and Dr. Charles W. Eliot is the president. The vice-presidents are Dr. William H. Welch and Henry P. Walcott. The secretary-general is Dr. Thomas A. Storey, College of the City of New York, New York City, U. S. A., from whom programs and further information can be obtained. The congress meets in three sections, for each of which a large number of papers is announced on the preliminary program. The sections and the subjects covered are as follows:

Section 1. "The Hygiene of School Buildings, Grounds, Material Equipment and Upkeep." This section will include papers on topics related to the location, plan, construction, equipment and up-keep of city, village and rural schools, open-air schools, private schools, boarding schools, summer camps and special schools for backward, truant, delinquent, deficient, defective and deformed children, *i. e.*, site, architecture, decoration, ventilation, illumination, cleaning system, plumbing, toilets, sewage disposal, school furniture, school books, water supply, drinking facilities, bathing facilities, swimming pools, school grounds, school athletic fields, fields for games, sport and play, lunch rooms and equipment, gymnasium, social rooms, rest rooms, libraries, laboratories, class rooms, study rooms and lecture rooms.

Section 2. "The Hygiene of School Administration, Curriculum and Schedule." This section will include all topics concerned with the hygienic factors found in school administration, curriculum and schedule as they apply to country, village and city schools; and to the modifications necessary for the best interest of our various special schools. Papers on such subjects as the following would belong to this section: Hygiene of the teacher; hygiene of the child; hygiene of the janitor and other school employees; hygiene of the schedule, growth and age; school fatigue; need for and management of school lunches and school baths; influence of the seasons; study periods; home work; recesses; vacations; athletics; the problems of heredity in relation to school hygiene; overcrowding; the teaching of hygiene; the training of teachers of hygiene; special phases of hygiene: as personal hygiene; oral hygiene; preventive hygiene; educational hygiene; community hygiene; sex hygiene; play; physical education; domestic hygiene; puericulture, and first aid; special plans for and results from the instruction of backward children, truant, delinquent and crippled children; the economics of school hygiene; relation to the home.

Section 3. "Medical Hygienic and Sanitary Supervision in Schools." This section will receive papers on the management, operation and results of medical, hygienic and sanitary supervision in public, private and special, country, village and city schools, colleges, universities and professional schools.

Such subjects as the following will be included: The control of health inspection; sanitary supervision; the organization of health departments in schools; the relationship to the board of health; the equipment, training

and compensation of school physicians; school nurses; school clinics; relation of health supervision in the schools to the practise of the physician, the dentist and the hospital; relation of medical and hygienic supervision in the schools to health supervision in the home; standardization of examinations; sanitary supervision of school rooms (class rooms), locker rooms, swimming pools, toilets, school books and school furniture; supervision of disease carriers; prevention of epidemics; follow-up methods and results; medical inspection and treatment; standardization of records.

SCIENTIFIC NOTES AND NEWS

McGILL UNIVERSITY held a special convocation on August 2 for the purpose of conferring honorary degrees in connection with the visit of the International Geological Congress to Canada. The degree of doctor of laws was conferred as follows: Helge Bäckström, Ph.D., professor of mineralogy and petrography in the University of Stockholm (presented by Professor Howard Barnes, F.R.S.); Alfred Bergeat, Ph.D., professor of geology in the University of Königsberg (presented by Professor Dale, M.A.); Alfred Harker, M.A., F.R.S., university lecturer in petrology in the University of Cambridge (presented by Professor John Macnaughton, LL.D.); James Furman Kemp, D.Sc., professor of geology, Columbia University, New York (presented by Professor McLeod, F.R.S.C.); Alfred Lacroix, D.Sc., professor of mineralogy at the Museum of Natural History, Paris (presented by Dean Adams, F.R.S.).

PROFESSOR W. A. BONE, F.R.S., has been awarded the Howard N. Potts gold medal for distinguished work in science or the mechanic arts by the Franklin Institute of Philadelphia, in recognition of his work upon surface combustion.

MR. JOHN TEBBUT, who has conducted a private observatory at Windsor, N. S. W., has recently celebrated two anniversaries, having entered on his eightieth year, and completed fifty years' membership of the Royal Society of New South Wales.

DR. HOMER DOLIVER HOUSE, associate director and lecturer on botany and dendrology of the Biltmore Forest School, has received the appointment of assistant state botanist of New York.

MR. A. R. HINKS, F.R.S., of the Cambridge Observatory, has been appointed assistant secretary of the Royal Geographical Society.

ACCORDING to *The Observatory* Mr. Edward Kitto has retired from the superintendence of the Falmouth Magnetic and Meteorological Observatory. In consequence partly of financial difficulties, the work of the observatory under its present constitution came to an end on June 30, but the department of terrestrial magnetism of the Carnegie Institution of Washington has arranged to carry on some of the observations for a few months longer.

SURGEON-GENERAL SIR DAVID BRUCE, head of the sleeping sickness commission which was sent to Central Africa nearly two years ago, has returned to England with Lady Bruce. Sir David will in a few weeks return to Nyasaland, where the other members of the commission are still working.

MR. CHARLES H. T. TOWNSEND, who was some time since especially charged by the Peruvian government with the investigation of the insect transmission of verruga, injected a dog with triturated females of *Phlebotomus* on July 11, and on July 17 secured as result an unmistakable case of verruga eruption. The gnats used for the injection were secured on the night of July 9 in Verrugas Canyon, a noted focus of the disease. This is the first experimental transmission of verruga by means of insects, and adds a notable case to the list of insect-borne diseases. The details of the experiment will appear shortly. Further transmission work in laboratory animals will be pursued at once, both by injections and by causing the gnats to bite.

FREDERICK G. CLAPP, managing geologist of the Associated Geological Engineers of Pittsburgh, Pa., and Alten S. Miller, of Humphreys & Miller, New York City, are examining the gas fields of Hungary in company with Professor Hugo Bockh, of that country.

Professor Vladimir Karapetoff, professor of electrical engineering at Cornell University, has started on a trip for the purpose of visiting hydro-electric developments and high-tension power transmission plants. He expects to visit the recent development on the Mississippi River at Keokuk, Iowa, and then go to Denver, Salt Lake City, Los Angeles, San Francisco, Portland and Seattle, and to attend the Pacific Convention of the American Institute of Electrical Engineers in Vancouver, B. C., September 9–13.

A French Arctic expedition, headed by Jules von Payer, sailed on August 10 for the purpose of exploring and gathering scientific data in Franz Josef Land.

Under the auspices of the Edinburgh Mathematical Society, a colloquium was held in Edinburgh from August 4 to 9, when courses of lectures were given on "Relativity and the new physical ideas of space and time," by Professor Conway; on "Non-Euclidean geometry," by Dr. Sommerville, and on "Harmonic and periodogram analysis," by Professor Whittaker.

A bronze panel has been unveiled at Lugar, Ayrshire, Scotland, in memory of William Murdoch, one of the inventors of coal-gas lighting. The panel, which takes the form of a life-size portrait medallion in bold relief, was placed on the wall of the cottage in which Murdoch was born.

The last legislature of the state of Pennsylvania appropriated $100,000 for the control of the chestunt bark disease during the biennium 1913–14. Governor Tener, after consulting with the Chestnut Tree Blight Commission, felt that this sum was inadequate for their task, and vetoed the appropriation. It is expected, however, that all the research work of the commission will be continued, in cooperation with the Bureau of Plant Industry.

The Independent quotes the following items from its issue of fifty years ago:

Professor Wolcott Gibbs, an able chemist, has been chosen Rumford professor at Harvard University. Columbia College a year or two since refused to appoint him to a chemical professorship. Because he did not understand chemistry? No; because he was a Unitarian! This is as if you should refuse to get your clothes of the best tailor because he did not make jack knives to suit you.

Mr. Cyrus W. Field has gone to England in furtherance of his favorite Atlantic Telegraph enterprise. Both ends of the proposed telegraph line are to be under the control of England. No American is a real friend of his country who will give a cent to help England at present to such a tremendous military engine as that.

The appointment of Professor C. F. Marvin as chief of the weather bureau of the Department of Agriculture made by the President of the United States was noted in Science last week. Before the secretary of agriculture nominated Professor Marvin for this position he had carefully considered a large number of names suggested from all sources and had sought the advice of a number of university administrators and scientific men and had asked the National Academy of Sciences to make recommendations. A committee of the National Academy gave the matter very careful consideration and its opinions were communicated to the secretary, who since has expressed his appreciation of this assistance. The committee of the National Academy of Sciences unanimously recommended the appointment of Professor Marvin. Meanwhile, the department, through its own sources of information, had come to the conclusion that Professor Marvin was the best man available for the position. Professor Charles F. Marvin was born in Putnam, Ohio, October 7, 1858. He graduated in mechanical engineering from the Ohio State University in 1883. He was instructor in mechanical and physical laboratory practise at this university for some time. He was appointed on the civilian corps of the signal service in 1884. On July 1, 1891, he was transferred to the Department of Agriculture when the weather bureau service was transferred, and was professor of meteorology. Professor Marvin has made important investigations of anemometers for the measurement of wind velocities and pressures, and on experiments conducted by him the tables used by the weather bureau for deducing the moisture in

the air are based. He has also invented important instruments for measuring and automatically recording rainfall, snowfall, sunshine, atmospheric pressure, evaporation, etc. He has made extensive studies in, and written on, the use of kites for ascertaining meteorological conditions in the free air, the registration of earthquakes, the measurement of evaporation, solar radiation, etc. He was detailed for special purposes to the Cotton States and International Exposition at Atlanta in 1895, to the Tennessee Centennial Exposition at Nashville in 1897, and to the Jamestown Exposition in 1907. In February, 1900, he was appointed a representative of the Department of Agriculture at the Meteorological Congress held in connection with the International Exposition at Paris. For some time he has been in charge of the instrument division of the Weather Bureau, an important branch of the department.

THE British secretary of state for the colonies has nominated a committee to report: (1) Upon the present knowledge available on the questions of the parts played by wild animals and tsetse flies in Africa in the maintenance and spread of trypanosome infections of man and stock. (2) Whether it is necessary and feasible to carry out an experiment of game destruction in a localized area in order to gain further knowledge on these questions, and, if so, to decide the locality, probable cost, and other details of such an experiment, and to provide a scheme for its conduct. (3) Whether it is advisable to attempt the extermination of wild animals, either generally or locally, with a view of checking the trypanosome diseases of man and stock. (4) Whether any other measures should be taken in order to obtain means of controlling these diseases. The committee will be composed as follows: Lord Desart (chairman); Mr. E. E. Austen, British Museum (Natural History); Dr. A. G. Bagshawe, Director of the Tropical Diseases Bureau; Dr. Andrew Balfour, late director of the Wellcome Research Laboratories, Gordon College, Khartum; Sir John Rose Bradford, secretary of the Royal Society; Mr. E. North Buxton; Dr. W. A. Chapple, M.P.; Sir Mackenzie D. Chalmers; Lieutenant-Colonel Sir W. B. Leishman, professor of pathology, Royal Army Medical College; Sir Edmund G. Loder, vice-president of the Zoological Society; Dr. C. J. Martin, F.R.S., director of the Lister Institute of Preventive Medicine; Mr. J. Duncan Millar, M.P.; Dr. P. Chalmers Mitchell, secretary of the Zoological Society; Professor R. Newstead, Liverpool University; Mr. H. J. Read, of the Colonial Office; the Hon. L. Walter Rothschild; Sir Stewart Stockman, chief veterinary office, Board of Agriculture and Fisheries; Mr. A. C. C. Parkinson, of the Colonial Office, will act as secretary.

THE production of coal in 1912 reached the great total of 534,466,580 short tons, valued at the mines at $695,606,071, according to a statement by Edward W. Parker, coal statistician, just issued by the United States Geological Survey. This year the report on the coal industry of the United States begins the fourth decade in which coal statistics have been published annually by the Geological Survey. In 1882, the first year of this period, the total coal production of the United States had reached what was then considered about high-water mark—103,551,189 short tons. In 1912 the production of bituminous coal alone in the state of Pennsylvania exceeded that figure by nearly 60 per cent. and the combined production of bituminous coal and anthracite in Pennsylvania in 1912 was two and one quarter times the total production of the United States in 1882. The total coal production of the United States in 1912 was more than five times that of 1882. In 1882 the United States was a poor second among the coal-producing countries of the world, Great Britain having an output exceeding that of this country by nearly 70 per cent. The United States supplanted Great Britain as the premier coal-producing country in 1899, and in 1912 it was as far ahead of Great Britain as that country was ahead of the United States in 1882. The United States at present is contributing 40 per cent. of the world's supply of coal and is consuming over 99 per cent. of its own production. In 1912 the production of coal in the United States not only surpassed all previous

tonnage records, but the average value per ton exceeded that of any normal year in the 33 years for which statistics are available. There has been only one year when prices generally were higher than in 1912, and that was 1903, the year of the fuel famine. The gain in output in 1912 over 1911 was 38,095,454 short tons and the increase in value was $69,040,860. The production of bituminous coal increased from 405,907,059 short tons to 450,104,982 tons, a gain of 44,197,923 tons, with an increase of $66,607,626 in value. The decreased production of anthracite, amounting to 6,102,469 short tons, was due entirely to the suspension of mining in April and May, when practically the entire region was idle. The factors which contributed to the increased output of bituminous coal were (1) the revival in the iron and steel industry, which stimulated production in the Eastern States, the coal made into coke showing, alone, an increase of nearly 6,000,000 tons; (2) bumper crops of grain and other agricultural products, which gave prosperity to the farming communities of the Middle West; (3) decreasing supplies of natural gas and fuel oil in the mid-continent field and their consequent lessened competition with coal from the southwestern states; (4) increased consumption by railroads and in nearly all lines of manufacturing; (5) activity in the mining and smelting of the precious and semiprecious metals in the Rocky Mountain and Pacific states. These factors combined made the year 1912 one of the rather rare prosperous years in the mining of bituminous coal.

In the House of Commons on July 24 Mr. Runciman gave, as we learn from *Nature*, an account of the work of the Board of Agriculture during the past session. Arrangements have been made for research on agricultural subjects to be carried on at a number of centers, including Rothamsted, Manchester, Birmingham, Oxford, Cambridge, the Royal Veterinary College, Leeds, Wye, Bristol and Kew, and grants amounting to £20,000 a year have been made for the purpose. In addition, £3,900 has been given for special investigations lying outside the scope of the program of the special institutes. All these investigations have reference to the great fundamental problems lying at the root of the agricultural and horticultural work of the country; the work is wholly scientific. In order to bring the scientific results into the region of practical farming a number of advisers have been set up whose function it is to advise farmers or county organizers in the light of the results of the scientific knowledge that is gained. A grant of £9,000 per annum has been made towards the salaries of these advisers.

The *Geographical Magazine* describes an important project for the construction of a vast port for the city of Milan destined to meet all possible future developments of internal navigation. The municipality has expressed approval of the project, and intends to apply to the state for powers to carry it into execution. Detailed studies have been carried out by MM. Beratta and Maiocchi, who, from wide experience of the most important river-ports of other European countries, have drawn up plans for the proposed port in respect of quays, wharfs, warehouses, railway and other communications, docks, workshops and installations of all kinds on the most approved modern principles. The total area to be covered by the port is 112 hectares (277 acres) of which about 50 acres will be occupied by the basins, an equal area by roads, railways, etc., 25 acres by the stations and the remainder by the quays. It is hoped to begin operations at an early date, so that the port may be ready by the completion of the great Venice-Milan waterway, which is to give passage to vessels of up to 600 tons burden.

The federal Lighthouse Bureau and the Forest Service are cooperating in forest work on the shores of the great lakes in the lumber states of Michigan and Wisconsin. The lighthouse reservations here include a total of nearly 5,500 acres, and range in size from 30 acres at Grand Island, Michigan, to 1,040 acres at Grand Marais. An examination is just being started to determine the best forest methods to pursue on the reservations. On some, from which the timber has been cut, white pine and Norway pine will be planted. On others the timber already growing will be

preserved through use. On two of the reservations, the forest experts point out, the opportunities are excellent for growing cedar and pine for spar buoys and piling, to be used in the work of the Lighthouse Bureau itself. All parts of the reservations can not be devoted to forests. Some areas will have to be left clear for protection from fire, while others immediately adjacent to the beacons themselves will have to be left bare in order that the lights may not be obscured.

A CONTRIBUTION on the great glaciers of Alaska is Bulletin 526 of the U. S. Geological Survey, "Coastal Glaciers of Prince William Sound and Kenai Peninsula, Alaska," by U. S. Grant and D. F. Higgins. The report is profusely illustrated with photographs and with maps of the individual glaciers, as well as two comprehensive maps of Prince William Sound and the southwestern part of Kenai Peninsula, showing the location of scores of glaciers. The report is in fact a guide and handbook to this wonderful scenic region which must prove invaluable to the tourist. Many valuable data and important measurements of glaciers in the United States, Alaska and elsewhere have been brought together from time to time, and it is probably the general impression that since the vast ice sheet which covered the northern part of North America began its retreat the glaciers of the continent have been continually shrinking. It is therefore interesting to note from the illustrations and descriptions in Bulletin 526 that some of these Alaskan glaciers are progressing and growing larger rather than retrogressing, many huge forests being upturned and devastated by the irresistible advance of the ice. In other glaciers the retreat within a period of ten years has been more than a mile. The great magnitude of some of these glaciers is seen in the descriptions, which indicate the height of the tidal ice cliffs that form the termini of the glaciers as being from 300 to 400 feet. Slowly moving down the mountain valleys, some of them steeply pitched and others relatively flat, these stupendous ice fields include billions of tons of ice. Many young Americans can find here memorials of their alma mater, for along College Fiord are Yale Glacier, Harvard Glacier, Smith Glacier, Bryn Mawr Glacier and Vassar and Wellesley glaciers.

UNIVERSITY AND EDUCATIONAL NEWS

As noted in SCIENCE last week, the governor of Pennsylvania has signed a bill appropriating the sum of $1,226,000 for the next two years, to the Pennsylvania State College. Two years ago the college received $800,000, out of which $200,000 was to be applied for the purpose of paying off a long-standing debt, so this year's appropriation is practically double that given two years ago. This is only in keeping with the great increase in students, as last year's enrollment, including summer school for teachers, was 2,535. The increase has been among the largest in the United States.

PROFESSOR LYMAN P. POWELL, head of the ethics department at New York University, has accepted the presidency of Hobart College.

THE following resignations have recently occurred at the Alabama Polytechnic Institute: Professor Jesse M. Jones, recently appointed head of the department of animal industry, has resigned to become field agent in cooperative farm demonstration work in the states of Maryland, Kentucky and West Virginia for the U. S. Department of Agriculture. L. W. Shook, formerly field agent in live stock work, has resigned to accept a similar position with the North Carolina Station, and Mr. T. C. Bottoms, herdsman, has resigned his position to take up similar work at the same station. Mr. J. M. Johnson, assistant in the department of animal industry during the past year, has resigned to pursue graduate work in the University of Missouri.

DR. G. E. GIBSON, of the University of Edinburgh, has been appointed instructor in chemistry in the University of California.

MR. R. A. JEHLE, of the Kansas State Agricultural College, instructor in plant pathology, has been appointed instructor in plant pathology at Cornell University.

PROFESSOR R. M. BROWN, of the geography department of the State Normal School, Worcester, Mass., has been appointed as head of

the department of geography at the Rhode Island Normal School, Providence, R. I.

At University College, Reading, Mr. S. B. McLaren, assistant lecturer in mathematics at Birmingham University, has been appointed professor of mathematics, and Mr. R. C. McLean lecturer in botany.

DISCUSSION AND CORRESPONDENCE

THE NAME OF THE SHEEP MEASLE TAPEWORM

Cobbold in 1866 described a cysticercus from the muscles of sheep in England and named it *Cysticercus ovis*. The same species was later described by Maddox (1873) under the name of *Cysticercus oviparіens*. Other authors have considered the parasite to be either *Cysticercus cellulosæ*, the intermediate stage of *Tænia solium*, in an unusual host, or *Cysticercus tenuicollis*, the intermediate stage of *Tænia marginata* or *hydatigena*, in an unusual location (muscles instead of serous membranes). Recent investigations by the present writer have proved that the parasite in question is neither *C. cellulosæ* nor *C. tenuicollis* but the intermediate stage of a distinct species of dog tapeworm. The correct name of this tapeworm would, therefore, seem to be *Tænia ovis* (Cobbold, 1866).

B. H. Ransom
Bureau of Animal Industry,
Washington, D. C.

NOTE ON THE ORIENTATION OF BOMBILIUS TO LIGHT

While on the hills east of Berkeley, Cal., I observed, among numerous insects visiting the flowers of certain shrubs, that there were several flies which kept hovering for a considerable time in almost exactly the same position. The flies proved to belong to a species of *Bombilius*. The instinct of hovering is not rare among the Diptera, especially the Syrphidæ, but what especially attracted attention was the accurate orientation of the hovering insects to the rays of light. In all the numerous cases observed the flies had their backs turned toward the sun, and in all cases the hovering occurred in the direct sunlight. Whenever a shadow was thrown upon a hovering fly it immediately darted elsewhere.

Occasionally the flies alighted on the ground, when they rested with the back exposed to the sun as before. When a shadow was thrown on them they would soon fly to a sunnier spot. In a few cases I caused them to orient obliquely to the sun's rays by slowly moving an object so that its shadow was thrown on only half the body of the insect; the body would then be turned so as to face more nearly the center of the shaded region. In basking in sunny spots and in orienting negatively to the rays of light the behavior of *Bombilius* resembles that of the mourning-cloak and other butterflies described by Radl and Parker. Like the mourning-cloak, *Bombilius* under ordinary circumstances is positively phototactic. It will fly or walk toward the light as so many other Diptera do, but when resting on the ground in the sunshine or hovering in the air it assumes a negative orientation. It is of interest to find such striking similarities of behavior in two distantly related orders of insects.

When resting on the ground or hovering, *Bombilius* often darts quickly at passing insects. It is not very discriminating as to the objects of its approach and was several times seen to follow after honey-bees and twice after yellow-jackets. When the fly meets a member of its own species the two often spin around in a rapid whirl, but when a mistake is made the pursuit is immediately abandoned. I have caused *Bombilius* as well as other species of hovering flies to dart after small pebbles that were tossed in the air. This behavior is probably associated with the instinct of mating, since it occurs in non-predatory as well as predatory species.

S. J. Holmes

SCIENTIFIC BOOKS

Handwörterbuch der Naturwissenschaften. Herausgegeben von E. Korschelt, *Zoologie;* G. Linck, *Mineralogie u. Geologie;* F. Oltmanns, *Botanik;* K. Schaum, *Chemie;* H. Th. Simon, *Physik;* M. Verworn, *Physiologie,* und E. Teichmann, *Hauptredaktion.* Jena, Verlag von Gustav Fischer. 1912.

In order to review a book it is at least extremely desirable to have read it. Reading the encyclopedia is not "jedermann's Sache" and, unlike Agamemnon in the story of the Peterkin family, the present writer can not pretend to have done it, but he has at least carefully examined each of the forty-six "Lieferungen" of 160 pages each, which have so far appeared of this admirable work, and has perused with care many of the articles on which he is competent to have an opinion. The first thing that must certainly strike the scientific man on opening this work is the feeling of regret that it is impossible to produce such a work in America, and, secondly, that, if it were, no publisher could be found to undertake it, for the, to him, very convincing reason that he would not be able to make any money out of it. Germany is preeminently the country of encyclopedias, and if one can judge of German greatness from the thoroughness with which they go about the manufacture of these aids to knowledge he can but wonder why the Germans have not already conquered the world. To be sure France is the home of what must always be known as *the* encyclopedia, to say nothing of Larousse and similar undertakings, and England is the home of eleven editions of the Britannica, to which in these latter days American methods of scientific management and booming have been added as well as British and American learning; but when we look at the "Encyclopaedie der mathematischen Wissenschaften," which has been appearing now for thirteen years, and is not yet complete, and which has compelled the French to publish a French edition based with great fidelity upon it, we must admit the impossibility of competition in this line.

The present work is, so far as known to the reviewer, the first attempt made, even in Germany, to produce an encyclopedia of all the natural sciences, and must put all scientists, as well as all liberally educated laymen who can read German (and the contrary is a negation of terms) under great obligations to the house of Fischer, so well known among the great publishing houses of scientific works. It seems rather a pity that mathematics could not be included, because, although not a natural science, it is, if not the greatest of the sciences, at least the common tool and competent servant of all. Of course mathematics is taken care of in the great work named above, but that is no reason that it should not have been treated in a briefer and less technical way in a work of the scope of the present one, and its exclusion results in the inclusion of articles largely of a mathematical nature, such as the one on Flüssigkeitsbewegung, which appear in the mathematical encyclopedia by the nature of things, and also appear here as physical articles. In this connection the reviewer may perhaps be permitted to animadvert on the absurd classification of mathematics with philosophy, say in the group system at Harvard, which removes it from its closest friends and relatives, physics, astronomy and chemistry, and puts it along with an almost total stranger, and calls it to the attention of people most of whom are totally unable to use it. So much for logic, so little for common sense.

What most impresses the reader of the work under consideration is the great competence of the writers of the articles, and their absolute up-to-dateness. To be sure, some of the authors are decidedly young, but their articles are none the less good, and we must bear in mind the great number in Germany of brilliant minds among very young men, at least in physics. As an example of contemporaneousness we find in the extremely interesting article on Flüssigkeitsbewegung by Professor Prandtl, of Göttingen, mention of the most recent researches on fluid resistance, illustrated by a beautiful photograph of vortex-motion, involving work done only last year, while the famous principle of relativity, which was invented only in 1905, is treated in several articles, although not under a special heading. The articles on radioactivity and other radiations, those on Luftfahrt and Luftpumpe are further examples, the latter giving an excellent description of Gaede's new molecular air pump, a characteristically German invention,

which, like the *America* in the yacht race, is first, with no second.

This encyclopedia will fortunately not fill a five-foot shelf, but if we may judge from the present 46 parts, reaching Skelett, may go about to 60 and fill a little over two feet. According to German custom, it is issued unbound, and the parts do not appear in strict alphabetical order, which makes a slight difficulty in knowing at the present time exactly what it will contain. Nevertheless, the paging will be perfectly consecutive, and the piecemeal method of appearance has the advantage of permitting the articles to have the greatest possible freshness, and does not lead to the errors that sometimes crept into the "Britannica" from the immensity of the task of printing. The only possible comparison of the present work is with the "Britannica," which, although of general scope, contains scientific articles which are of the same general caliber as these. In both cases the articles are not popular, and are written by thoroughly competent writers, but at the same time they are interestingly written, and so clear as to be understood by the layman desiring to obtain exact knowledge. The present encyclopedia is issued at 2.50 Marks per part, so that if there shall be sixty, the cost of the whole will be less than forty dollars, exclusive of binding, a price that will make its ownership possible to many a scientific man to whom the "Britannica" at one hundred and twenty-five dollars would be an impossibility. The form of the page is also much more convenient than that of the "Britannica," and the volumes are less unwieldy. The print is as good, if not better, although decidedly different, the type being blacker and somewhat clearer, although not leaded, so that it is not easy to say which is the easier to read. The printing is, however, certainly as good, and the illustrations, at least in the opinion of the reviewer, are decidedly better, some of the biological illustrations being beautiful to look at, and even the physical ones being remarkably clear. The reviewer admits with pain that many of the cuts in the "Britannica" have to him a decidedly cheap look, which is never the case in the German work. These are photoengravings of a high quality of workmanship, and are used in great profusion. For instance, in the article Ei und Eibildung we find a thirty-three-page article profusely illustrated with beautiful and instructive cuts, while in the article Egg in the "Britannica" we find an article of three and a half pages, without a single picture. Undoubtedly the matter of the article is found somewhere else, but as a matter of fact the article on Embryology is similarly devoid of illustrations. Whether this is due to the smaller expense of printing illustrations in Germany we do not know, but the presence of the illustrations is a very desirable feature.

It is obviously impossible for any individual scientist to comment on all the sciences, so that the reviewer will confine himself to singling out a few articles on subjects with which he is familiar. The article on Elektrooptik is by Professor Voigt, of Göttingen, the chief authority on the subject, and the article on Lichtbogenentladung, a forty-page article on a new subject, by Professor Simon, of Göttingen, is a mine of information on that subject, with very attractive figures, reproductions of oscillograms by the author. All the electrical articles are well handled; we will mention only that on Elektrodynamik, by H. Scholl, which includes the treatment of all the theories from the classical ones down to the theory of relativity, in compact and clear statement, and that on Elektrische Masssysteme, by F. Emde, in which, beside a very clear treatment of the subject, we find a very ingenious graphical treatment by a diagram showing not only the dimensions, but also the relative magnitudes of the most important dynamical units. For the sake of comparison we will consider the articles on Elasticity in the "Britannica" and the present work in some detail. In the "Britannica" we have a nineteen-page article by Professor Love, of Oxford, the author of the leading treatise on the subject in any language, in which the leading equations of the theory are stated, with the chief practical results, without any great mathematical detail. In the German work we have an article of twenty-seven pages

by Dr. Th. v. Kármán, who, although a very young man, has no need to apologize for his article, which, although containing fewer formulæ, is written with great clearness and has even better cuts than the English article. To be sure Dr. Kármán had the advantage of reading Professor Love's article as well as his great treatise, but the article is decidedly independent, and concludes with an excellent treatment of elastic hysteresis or Nachwirkung, which is becoming more and more important, and which we do not find mentioned in Professor Love's article. Very likely this is also due to the more recent appearance of the German work. For the biologist we will mention the fifty-three-page article on Descendenztheorie, profusely illustrated, as compared with the "Britannica" article on Evolution, of fifteen pages, without illustrations.

A feature of the present work that is of great importance is found in the biographical sketches, which, although very short, are decidedly helpful. We have looked in vain for the name of Mendel, but find three generations of Becquerels. It is a pleasure to note throughout the work frequent references to the work of Americans, living and dead, of whom we may mention Rowland, Newcomb, Michelson, R. W. Wood, Campbell, E. B. Wilson and W. M. Davis, whose familiar hand is recognized in the admirable drawing of meanderings in the article Fluss. This fact, which is now becoming more and more general, may partially reconcile us to the state of affairs upon which we have commented at the beginning. It may seem premature to review a work that is not yet finished, but it seems of importance to call the attention of the public to this very important and desirable work.

ARTHUR GORDON WEBSTER

July 26, 1913

Studien an intracellularen Symbionten. I. Die intracellularen Symbionten der Hemipteren. By Dr. PHIL. PAUL BUCHNER, Privatdocent in the University of Munich. Reprinted from "Archiv für Protistenkunde," Vol 26. Jena, 1912. Pp. 116, 12 plates and 29 text figures.

For many years students of insect morphology and embryology have noted in the fat body of larval and adult insects and in certain eggs and embryos, peculiar corpuscle- or rod-like bodies, seemingly extraneous in origin and whose nature and function could not be satisfactorily explained.

Thus, as far back as 1850, Leydig observed the appearance, in embryos of viviparous aphids, of "a green or yellow granular mass which at first apparently lay free between the cells, but later massed in spherical form, became enclosed by a membrane, and took part in the formation of the vegetative organs of the insect." This constituted the mass later designated by Huxley and by Lubbock as the "pseudovitellus," a name very generally accepted by embryologists, though some have regarded the mass as having a very specific function. According to Babiani, who demonstrated its origin within an enlarged cell of the follicular epithelium, it represents the vestigial male sex gland of the agamic individual. On the other hand, Witlaczil regarded it in the form of the "green body" of the adult aphid, as an excretory organ, replacing the Malpighian tubes which are lacking in some species.

Of less striking appearance are the bacteroidal bodies found by Blochmann, '84, in the eggs of certain ants and, later, studied more fully by him in the eggs and adult fat body of *Blatta* and *Periplaneta*. These little bodies, which Wheeler, '89, called Blochmann's corpuscles, have also been found in the larval fat cells of *Pieris* and in various orthoptera. They are in the form of minute, straight or slightly bent rods, 6–8 μ long and, as Blochmann was able to determine, multiply by cross division. He was unable to cultivate them, but regarded them as symbiotic bacteria.

In recent years there has accumulated evidence to show that these scattered structures are related and that Blochmann was right in interpreting them as symbiotic forms. Many such suggestions appear in the literature of the past fifteen or twenty years, but it is especially the work of Mercier (1906), Sulc (1906

and '10), of Pierantoni (1909 and '10), who succeeded in isolating and growing certain forms in pure culture, that has furnished the basis for a correct interpretation and for a comprehensive study of these bodies in the various groups of insects.

Such a study has been commenced by Dr. Buchner and the extensive paper before us considers primarily the intracellular symbionts of the hemiptera. There is a very full historical discussion which will be of great value to other students of the general subject, and which will serve to put the reader, be he botanist or zoologist, *en rapport* with the topic. Then follows a detailed discussion of the author's own investigations.

Of special interest are the data on the method of infection of the developing eggs by the organisms. This may take place in a diffuse manner, as in the cockroaches, or it may be very definitely localized, as in the aphids. In any event, we are concerned with a hereditary transmission of bacteria-like or yeast-like organisms.

Concerning the systematic position of the forms studied there is little definite to be said, though it is certain that the intracellular symbionts of insects, as we know them at present, do not represent a closely definable group. The forms in the cockroaches are apparently true bacteria and probably so also are those of the ants.

On the other hand, the multiplication by budding, the type of mycelial formation, the lack of structures comparable to spore of bacteria, the constant presence of a nucleus, and other characters in the other forms studied are suggestive of the yeasts, and it is here that most of the recent students of the subject are inclined to place them. Thirty-four species, some of them new, loosely grouped here, are described and figured.

It is obvious from Buchner's studies that these puzzling organisms are not to be regarded as parasites. So striking are some of the specializations and adaptations which their presence has brought about, that it is equally impossible to regard them as mere commensals. But certain as the author is that he is dealing with true symbionts, he is unable to explain, satisfactorily, the advantage which accrues to the host.

Dr. Buchner's work is of fundamental importance, but one must agree with him that it is but a beginning. With the foundation work done, the next few years should see wonderful advance in our knowledge of this difficult subject.

Wm. A. Riley

Cornell University

BOTANICAL NOTES

Some statistics as to the flowering plants

In this inquiry I have considered only the proper Flowering Plants, Anthophyta or "Angiospermae," and have given most of the numbers in thousands, for easier memorizing.

Number of species of Flowering Plants	±132,500
Dicotyledons	±108,800
Monocotyledons	± 23,700
In the Dicotyledons:	
Axiflorae	± 54,000
Calyciflorae	± 54,000
In these again:	
Axiflorae—apopetalae	± 29,000
Axiflorae—gamopetalae	± 25,000
Calyciflorae—apopetalae	± 33,000
Calyciflorae—gamopetalae	± 21,000
So there are:	
Of Apopetalous Dicotyledons	± 62,000
Of Gamopetalous Dicotyledons	± 46,000
Again, there are in Dicotyledons:	
Ovaries, superior	± 72,000
Ovaries, inferior	± 36,000
Those with superior ovaries are distributed as follows:	
In Apopetalous species	± 50,000
In Gamopetalous species	± 22,000
Those with inferior ovaries are distributed as follows:	
In Apopetalous species	± 14,000
In Gamopetalous species	± 22,000
In the Monocotyledons:	
With ovaries superior	± 12,000
With ovaries inferior	± 11,000
In Monocotyledons gamopetaly has not become established.	
So there are in the Flowering Plants:	
Of Apopetalous species	± 86,000
Of Gamopetalous species	± 46,000

And again there are:

With superior ovaries	± 84,000
With inferior ovaries	± 48,000

TWO BOOKS ON TREES

FROM the botanical garden and arboretum of the University of Michigan we have a little book of somewhat more than two hundred and seventy-five pages entitled "Michigan Trees: A Handbook of the Native and Most Important Introduced Species," by Charles H. Otis, curator. In its preparation the author has aimed to produce a book that would stimulate interest in the study of trees, having ultimately in view the betterment of forest conditions in the state. By means of keys ("summer" and "winter"), good pictures and clear descriptions it is made possible for any one of ordinary intelligence to find out what is the name and general relationship of any of the trees commonly found in Michigan. In order that it may be widely distributed the regents of the university have arranged to send one copy of the book free to every legal high school in the state, to every public library, nature study club, and finally to every resident of the state "who desires it." Surely the residents of Michigan, old and young, have no excuse hereafter for not knowing the trees growing about them.

The second book is Monograph 8, of the Geological Survey of Alabama, and is Part 1 of the "Economic Botany of Alabama," by Roland M. Harper, this part being devoted to the forests of the state (228 pp.). The book opens with a map of the state, in colors, showing geographical and forest regions. Starting with the remark that "Alabama has probably been more thoroughly explored by various kinds of scientists than has any other southern state," the author gives first of all a bibliography of Alabama forestry, and follows it with chapters on the natural regions, as the Tennessee Valley, Coal Region, Coosa Valley, Blue Ridge, Piedmont Region, Central Pine Belt, Black Belt, Southwestern Pine Hills, etc. In each region after geographical, geological and climatic details lists of trees are given, followed by a discussion of certain economic aspects. Then follow many half-tone reproductions of photographs of forests and forest matters. An interesting feature of these illustrations is that the exact dates when the photographs were taken are given. An unusually full index closes the report.

SOUTHERN SYSTEMATIC BOTANY

TEN years ago Dr. John K. Small, head curator of the museum and herbarium of the New York Botanical Garden, brought out his "Flora of the Southeastern United States," covering the region south of the southern line of Virginia, Kentucky, Missouri and Kansas, and east of the 100th meridian. The book has proved so useful that the author has been encouraged to bring out a second edition. This has been done by the rewriting of 144 pages, and the addition of 53 pages of descriptions of additional species in the appendix, making nearly 200 pages of new matter in the whole book. Since the book contains about 1,400 pages the amount of revision is easily made out.

The same author's "Flora of Miami" (206 pp.) contains descriptions of the native gymnosperms and angiosperms of southern Florida. In looking it through one is as much struck by the absence of certain well-known genera as by the presence of others which are quite unfamiliar. Thus *Carex* is unrepresented, as are also *Ulmus, Populus, Brassica, Taraxacum, Rosaceae, Malaceae,* etc., while of *Ranunculaceae* there is but one species; *Salix,* one species; Mints, eight species; *Helianthus,* one species. Florida tourists should have this handy little book for use in the southern part of the state.

A third book by Dr. Small will also be of interest to Florida tourists. It bears the title "Florida Trees" (107 pp.) and is intended to be a handbook of the native and naturalized trees of the state. When we realize that "nearly one half of the trees known to occur naturally in North America north of Mexico and the West Indies grow naturally in the relatively small area of the state of Florida" the importance of this little book may be appreciated. By actual count there

are here included 365 species. Of these 15 species are gymnosperms; 10, palms; 23, oaks; with 43 species of *Crataegus*.

These three books are published by the author.

SHORT NOTES

A NEW edition of the "Guide to the Spring Flowers of Minnesota" (by Clements, Rosendahl and Butters) has just appeared, so broadened and extended as to include the plants that ordinarily blossom by the middle of June. Small but helpful figures of about 160 genera are now given in the text. The plan of these "Guides," of which half a dozen have been published, is to be highly commended.

ANNOUNCEMENT is made of the early appearance of a book on "Rocky Mountain Flowers," by F. E. and E. S. Clements. It is to be "an illustrated guide for plant-lovers and plant users" and is to contain twenty-five colored plates, and about as many uncolored. An examination of some of the colored plates indicates that they will be highly artistic as well as botanically accurate. The volume is bound to be one that will appeal strongly to those who "summer" in the Rocky Mountains.

CHARLES E. BESSEY
THE UNIVERSITY OF NEBRASKA

SPECIAL ARTICLES

THE APPLICABILITY OF THE PHOTOCHEMICAL ENERGY-LAW TO LIGHT REACTIONS IN ANIMALS

IT has been pointed out by Loeb that tropistic light reactions in animals should follow the law of Bunsen and Roscoe. This law states that in a light reaction the effect is proportional to the simple product of intensity and time. It was first proved to be true for the formation of hydrochloric acid from chlorine and hydrogen and for the blackening of silver chloride under the influence of light. Later it was found to apply to the phototropic curvature (Fröschel, Blaauw) of plants, as well as to the human eye, though within rather narrow limits (Bloch, Charpentier). For light reactions in animals it has frequently been stated that they do not follow this simple law. A large number of forms seem to react to changes of intensity only, the effect in this case being proportional to the amount of change per unit of time. This is particularly true of the stimulating and inhibitory reflexes of the locomotor apparatus, as shown by a large number of investigators.

It occurred to me that it might be possible to get proof for the applicability of the energy-law by using a reaction which did not involve the locomotor organs. The eye movements of *Daphnia* seemed to afford a suitable object for the study of this question. These movements were first observed by Radl and his observations were confirmed and extended by myself some years later. The spherical eyeball containing a number of radially arranged ocelli is capable of rotation and held in position by several thin muscles inserted at its periphery. The eye shows a definite normal position with regard to light, a certain axis of the sphere having to be placed in such a direction that the ocelli on all sides of this axis get an equal amount of illumination. The muscles keep the eye in this position and one can cause rotating movements of the eyeball, by shifting the position either of the source of light or of the animal. The eye will always maintain its fixed position to the source of light, no matter whether the body of the animal follows the eye or not. An unequal state of tension of the eye muscles seems to cause locomotor movements, which tend to restore the normal relative position of eye and body. By fixing the animal on a slide it can be prevented from moving and the eye movements may be observed at leisure. Instead of shifting the position of the light the eye can be placed in a position of equilibrium between two sources of light and eye movements can be caused by increasing or decreasing the intensity of either of them. This shows these movements to be a function of the intensity of illumination.

In order to test the energy law, it is necessary to combine different light intensities with different times of exposure. If the product of time and intensity, *i. e.*, the amount of radiant energy brought to bear on the eye, is the same, the eye will always give the same

reaction. To this end I proceeded in the following manner. The animal was fixed in a definite position on the stage of a microscope, illuminated from below by a weak electric light of constant intensity. The microscope stood in a blackened dark-room. Through a hole in the wall of the room the light of an 80 candle-power Tungsten lamp fastened outside could enter. The light was made diffuse by a sheet of oiled paper fixed across the opening. The hole was 55 mm. in diameter and was closed by a piece of cardboard containing two diaphragms of varying sizes, side by side. A shutter with a spring motion could alternately close either the one or the other opening. I could thus make an instantaneous change from a stronger to a weaker light, and *vice versa,* by using diaphragms of different sizes and moving the shutter to and fro. One diaphragm was maintained at constant size (25 mm. diameter) and a sector wheel or episcotister, driven by a small electromotor, could be rotated before it. The light passing this diaphragm had an intensity of 0.9 c.p. The distance between the animal and the diaphragm was about 60 cm. Obviously, if two diaphragms were used whose areas were as 1:10 and a sector wheel with 1/10 of the periphery cut out were rotated before the larger one, so as to let light pass during 1/10 of a revolution, then equal amounts of radiant energy would reach the eye of the animal through either diaphragm.

The microscope was placed in such a position that the light from the diaphragms could fall on the stage from the side. If the smaller diaphragm was opened, the eye of the *Daphnia* took up a position, defined by the ratio of intensities of the light coming from the weak lamp below and from the diaphragm above. Changing from the smaller to the larger diaphragm would cause a change in the position of the eye. By varying the sizes of the diaphragms I found that a noticeable reaction was obtained upon changing from one diaphragm to the other, even when the difference between their areas was as small as 10 per cent. Change between diaphragms of equal size, however, did not produce a reaction.

Using the diaphragm ratios 5:10, 2.5:10 and 1:10 I invariably found that upon using a sector wheel cutting down the time of exposure for the larger diaphragm so as to make the amount of energy equal to the smaller one, I obtained *no reaction* on change from one to the other. If I used sector wheels giving too long or too short exposures, a reaction was noticed, where the error exceeded 10 per cent. *These observations prove that for the eye movements of Daphnia the energy law holds within the limits of accuracy characteristic of the reaction.* The speed of the sector wheel in these experiments was about 1/30 of a second for one revolution. If slower speeds were used, marked deviations from the law began to appear, the intermittent having a weaker effect than the constant light. In some cases I got a marked reaction of the eye on change from constant to intermittent light of equal energy when the speed of the sector wheel was about 1/10 of a second per revolution. The deviation becomes more marked, the slower the speed. The explanation for this phenomenon will be dwelt upon in a subsequent paper.

Strictly speaking, the law proved by my experiments is not the Bunsen-Roscoe law, but the law discovered more than twenty years earlier (1834) by Talbot, which states that the effect of intermittent light equals that of a constant light, if it emits the same amount of energy through a given period. In our case it means practically the same as Bunsen-Roscoe's law, each revolution of the sector wheel constituting one period, in which there is a given relation between intensity and duration of the light flash and a definite time for reaction. The variously arranged sector wheels provide the possibility of testing different ratios. The constant light coming from the smaller diaphragm is used in such a way as to serve as a measure or standard of comparison and circumvent the necessity of determining a threshold of stimulation.

WOLFGANG F. EWALD

THE ROCKEFELLER INSTITUTE,
DEPARTMENT OF BIOLOGY,
July 14, 1913

THE IOWA ACADEMY OF SCIENCE

The twenty-seventh annual meeting of the academy was held in Alumni Hall, Iowa State College, Ames, beginning at 1:30 P.M., Friday, April 25.

President Pearson, of the Iowa State College, extended a welcome to the academy at 8:00 P.M., Friday. After this the public address on "Wealth from Worthlessness" was given by Dr. Thomas J. Burrill, professor emeritus of botany, University of Illinois.

PROGRAM

(Abstracts are by the authors)

Tramping about Puget Sound: T. H. MacBride.

Pure Lines and What they Mean to Iowa's Grain Crop: L. C. Burnett.

The Physiology of the Pollen of Trifolium pratense: J. N. Martin.

The Comparative Morphology of the Legumes: J. N. Martin.

A Preliminary List of the Parasitic Fungi of Boone County, Iowa: H. S. Coe.

A Partial List of the Parasitic Fungi of Decatur County, Iowa: J. P. Anderson.

The Pollution of Underground Waters with Sewage through Fissures in Rocks: Henry Albert.

The possibility of pollution of underground waters through fissures in rocks has long been a well-established fact. The actual demonstration of such as the source of cases or epidemics of disease in Iowa has until recently not been proved. The more superficial rocks of the state present many joints or fissures. Although the epidemic of typhoid fever in Cedar Falls during 1911 was believed at that time to have occurred as a result of the pollution of waters through fissures in rocks, it is believed now that pollution occurred through a wooden conduit which conducted the water from the spring to the pumping station. The best example that we have of an epidemic no doubt traceable to pollution through fissures in rocks is the epidemic of typhoid fever which occurred at Fort Dodge during the summer and fall of 1912, during which about one hundred persons were affected by the disease. The water supply of Fort Dodge comes principally from the deep wells. They also take the water from pipes beneath the river. The source of infection was apparently both from the pipes beneath the river and from one of the deep wells. The feature of interest is in connection with the latter. This well (well No. 1), which was the first of the three wells as also the deepest one—being 1,827½ feet deep and extending to the Jordan sandstone—was started at the bottom of a large shaft which was constructed several years previously for the purpose of supplying the city with water. This shaft, which measures 10 × 10 feet across, extends down for 90 feet. From the west side of the lower end of this shaft a tunnel of 9 feet in diameter was extended under the Des Moines River. This tunnel was driven in sandstone, so required but few timbers for support, whereas the shaft has a wooden casing for almost its entire extent. The shaft extends successively from above downward through the following layers of earth:

Alluvial soil and clay	31 feet
Limestone	6 feet
Shale, blue	27 feet
Limestone	6 feet
Sandstone	42 feet[1]

There are only about 20 feet of gravel, alluvial soil and clay from the bottom of the river to the first layer of limestone. Through this the water from the river and surrounding soil will probably pass quite readily and without efficient filtration. It then comes to a layer of limestone which is known to contain many fissures, through which water may readily enter the shaft. Beneath the limestone is a layer of blue shale, 27 feet in thickness. This is relatively impermeable to water, hence tends to keep the water from passing directly downward and so hastens the passage of water laterally along the limestone fissures—in the direction of least resistance—namely, toward the shaft. Previous to the construction of the tunnel the seepage into the shaft was at the rate of about 55 gallons per minute. This was increased to 80 gallons per minute by the construction of the tunnel. This would seem to indicate that the water which enters the shaft is of recent surface origin. That the water must have come principally through such fissures in the rocks is indicated by the fact that when the shaft was constructed but little water appeared until after the limestone layer with its fissures had been entered. That the water which comes from the shaft is polluted with sewage material has been shown repeatedly by clinical and bacteriological examinations. When the first artesian well was drilled (well No. 1) it was started from the bottom of the above-mentioned shaft. The casing of this well extends through the shaft and projects at the

[1] Tunnel in this formation.

top several feet above the level of the water in the shaft. The water flowing from the artesian well fell into the shaft which became filled with water to the top of the discharge pipe. In this manner the water from the artesian well and the seepage water from the shaft and tunnel were mixed. Soon after the completion of this artesian well a sample of this water was sent to us for examination. We expected to find either no bacteria or only a very few. We found, however, that the bacterial count went up to 42 per cubic centimeter with two colonies of colon bacilli. Chemical examination likewise showed evidence of contamination with sewage material. The reason for this was not explained until after a personal inspection and subsequent examination showed that the contamination occurred in the large shaft with water from the shaft and tunnel. The water taken directly from the well did not show any evidence of pollution. We believe that the water of the tunnel and shaft comes largely quite directly from the river through fissures in the rocks and hence is not properly filtered.

Bacterial Activities and Crop Production: P. E. BROWN.

The importance of soil bacteria in bringing about the change of insoluble material containing the essential plant food constituents into forms which are available for the feeding of crops is emphasized as a basis for the assumption that there should be some relation between essential bacterial activities and actual crop production. Determinations of total numbers of organisms using an albumen agar and estimations by the beaker method of the ammonifying power and the nitrifying power of the soils of several series of field plots were made. Comparison of the results of these bacteriological studies with the actual crop yield revealed the fact that in practically every case a soil showing greater numbers of organisms, greater ammonifying power and greater nitrifying power than another soil showed likewise greater crop production. Fresh soil with a solution of casein added for ammonification and a solution of ammonium sulfate added for nitrification allowed of the greatest differentiation according to bacterial activities of the soils tested.

The Monterey Conifers: THOMAS H. MACBRIDE.

A discussion of the distribution and habits of the four conifers, *Cupressus macrocarpa* Hartweg, *Cupressus Goveniana* Don, *Pinus muricata* Don and *Pinus radiata* Don, which are found in the vicinity of Monterey, California.

Quercus borealis Michx. f.: B. SHIMEK.

This is generally regarded as a synonym of *Q. rubra,* but it seems to be quite distinct. The paper contains a discussion of its characters and its distribution in Iowa.

The Sedges of Henry County: JOHN THEODORE BUCHOLZ.

A discussion of the physiography and topography of Henry County with special reference to the distribution and habitats of the sedges, followed by an annotated list of the species found in Henry County.

The Diclinous Flowers of Iva xanthiifolia Nutt.: CLIFFORD H. FARR.

The placing of this species among the Compositæ is favored by the fact that the walls of adjacent stamens unite by the fusion of contiguous cutinized layers. Furthermore, the flowers are arranged in a capitulum in concentric cycles of five flowers each. The outer cycle consists solely of pistillate flowers, and the remaining cycles are made up entirely of staminate flowers. The abortive stamens of the pistillate flower appear after the carpels, and were seen occasionally to have developed into pollen-bearing members. It is evident that the stamens of the marginal flowers, being epigynous, would come in contact with the enlarged ends of the corollas of adjacent staminate flowers and with the apices of the floral and involucral bracts. That this crowding may have caused the abortion of these stamens seems credible. The abortive pistil of the staminate flower doubtless aids in dehiscence by engaging the hook-like tips of the stamens. It possesses no ovary, but early develops a notch on its apex, which suggests its derivation from the typical bifid form. The gynœcium of a flower is more susceptible, both in structure and in function, to the effects of desiccation than is the androœcium. The central flowers of this form are more exposed than the marginal on account of the following circumstances: their distance from the involucral bracts, their tardy appearance, the minuteness or absence of floral bracts of the disc flowers, the convexity of the receptacle, and the remoteness of the disc flowers from the main vascular supply. It therefore seems that exposure to desiccation through many generations will explain the abortion of the pistil in the disc flowers. Excessive exposure of certain flowers and excessive protection of others are therefore suggested as the major causes for the origin of decline in this species.

The Effect of Smoke and Gases upon Vegetation: A. L. Bakke.

Industrial centers have succeeded in having associated with them a large quantity of smoke. Under ordinary conditions the amount of smoke decreases with the increase of the distance from the business center. In making a study of two smoke districts of Chicago it has been found possible to use plants as an index to the amount of smoke present.

Aroid Notes: James Ellis Gow.

The taxonomy of a number of species of Aroids, chiefly tropical, has been worked out and is here presented for the first time.

Phylogeny of the Monocotyledones: James Ellis Gow.

Researches on the morphology of the Aroids, with special reference to the phylogeny of the group, have led the author to question the theory as to the primitive character of the monocotyledonous plants; and he here defends the view that the most primitive forms are to be found among the spiral Dicotyledones.

The Grasses of the Uintah Mountains and Adjacent Regions: L. H. Pammel.

Brief account of grasses collected in the Uintah Mountains and the adjacent regions based on collections made by the writer during several seasons in which the flora of the region was studied. The paper records the habitats, distribution and abundance of the species.

Notes on the Flora of Johnson County, Iowa: M. P. Somes.

An annotated list of plants observed growing in Johnson County, Iowa, comprising 1,008 species, representing 413 genera, included in 101 families. Not including mosses, fungi or the other cryptogams lower than the ferns.

The Electrical Conductivity of Solutions of Electrolytes in Aniline: J. N. Pearce.

Equilibrium in the System; Cobalt Chloride-pyridine: J. N. Pearce and Thomas E. Moore.

The Osmosis of Optical Isomeres: A. R. Johnson.

Observation on the Specific Heat of Milk and Cream: Johnson and Hammer.

A New Design for Specific Apparatus: Johnson and Hammer.

A Proposed Method for Determining the Ratio of Congealed to Uncongealed Water in Frozen Soil: Johnson and Ray Smith.

Factors in Milk Production: Frank B. Hills.

By a microscopical examination of many samples of milk of different fat composition percentages, numerous counts were made of the numbers of fat globules of different sizes. A positive relation was found to exist between the percentage fat composition of the milk and the numbers of globules of different sizes, the correlation coefficient being .19. A study of the tabulated fat records of about 3,700 pairs of variates, taken from the Advanced Register Year Book of the Holstein Friesian Association, showed by a correlation coefficient of .29, evidence of so-called prepotency of dams in the transmission of fat production to their daughters. This would indicate a probable sex linkage of some of the factors in the inheritance of fat production. A rearrangement of the data into groups for the study of the fat production of three consecutive generations of animals showed segregation of fat factors in a 7:1 ratio, giving further evidence of linkage of some of the factors in the inheritance of fat content in milk.

Nitrogen and Chlorine in Rain and Snow: Nicholas Knight.

Twenty-six specimens of rain and snow were carefully collected during the year 1911–12, and the amount of nitrogen in the nitrites, nitrates, free and albuminoid ammonia estimated. The amount of nitrogen that an acre of land received from each precipitation was computed. Chlorine was found in each specimen in which it was sought. This must come from the oceans as common salt.

Exhibition of Barograph and Thermograph Tracings of the Omaha Tornado: John L. Tilton.

The Limestone Sinks of Floyd County, Iowa: A. O. Thomas.

Notes on the Nebraskan Drift of the Little Sioux Valley in Cherokee County: J. E. Carman.

The Wisconsin Drift-plain in the Region about Sioux Falls, South Dakota: J. E. Carman.

Some Additional Evidence of Post-Kansan Drift near Iowa City, Johnson County, Iowa: Morris M. Leighton.

The Rock from Solomon's Quarries: Nicholas Knight.

A specimen of what is locally known as the "Royal" was received from Jerusalem for analysis. It was of the purest white, soft when first removed from the quarry, but it soon hardens on exposure to the air. The rock is very pure calcium carbonate, with little more than a trace of magnesium carbonate.

Iowan Cretacic Sequence: CHARLES KEYES.

Deposits homotaxially equivalent to the Cretacic, or Chalk, formation of England were first recognized on the American continent along the Big Sioux River in a district which is now incorporated in the state of Iowa. This correlation was almost the first attempt to apply the fossil criteria to the rocks of this country. Less than a decade had elapsed since this means had been formulated by William Smith in England. The use of the method was introduced in 1809 by Thomas Nuttall, an English botanist who during the following year ascended the Missouri River from St. Louis. Notwithstanding the fact that this region was visited repeatedly during a whole century which has elapsed since Nuttall's visit, it has been only within the last year that the complete Cretacic section in Iowa has been with certainty determined. The total thickness of the beds is now known to be not less than 800 feet. It is separable into seven distinct terranes. These are defined as the Nishnabotna sandstones, the Sergeant shales, the Ponca sandstone, the Woodbury shales, the Crill limestone, the Hawarden shales and the Niobrara limestones.

Terranal Differentiation of Devonic Succession in Iowa: CHARLES KEYES.

Upon faunal grounds, as well as for lithological and stratigraphical reasons, the main Devonic limestones of Iowa, or the Cedar Valley formation as they are most widely known, were found more than a score of years ago to be separable into five well-defined terranes. No special geographic names were attached to these several subdivisions. They are, however, commonly recognized as valid by all who have studied the field in detail during the term of years mentioned. Calvin published the general section with these division-lines indicated but he gave no distinctive local designations. The terranes are easily distinguishable over wide areas. For the lower number the title Fayette formation is retained. The others are called the Solon, Rapid, Coralville and Lucas formations. The subdivisions are briefly characterized.

Possible Occurrence of Tertiary Deposits East of the Missouri River: CHARLES KEYES.

Deposits of Tertiary age have never been recognized as occurring within the limits of Iowa. Their presence, however, has long been surmised. The repeated invasions of glaciers have naturally removed nearly all vestiges of any soft rocks which may have existed in pre-glacial times upon the older indurated strata.

The majority of such remnantal deposits are easily mistaken for phenomena connected with the glacial drift-sheets. Yet there are several of these sections along the Big Sioux River, for instance, the beds of which appear not to be of glacial origin. They seem to belong to isolated patches of the Tertiaries which are fully represented in the eastern parts of South Dakota and Nebraska. One pocket in particular, exposed near Sioux City, and called the Riverside sands, now appears to be unquestionably Tertiary in age.

Wright's "Ice Age" on the Genesis of Loess: B. SHIMEK.

In the second edition of Wright's "Ice Age" objections are made to the æolian hypothesis of loess origin. This paper aims to meet these objections, and sustains the æolian hypothesis.

Preliminary Note on the So-called Loess of Southwestern Iowa: JAMES ELLIS GOW.

This is a discussion of the nature and origin of a clay found in Adair County at the surface of the drift. It contains no gravel or bowlders and in near-by localities has been described as "loess." Investigation shows that it is neither aqueous nor æolian in origin and that it may occur in the Kansan drift at any and all depths.

The Proper Use of the Geological Name, Bethany: JOHN L. TILTON.

The term Bethany Falls limestone, or Bethany limestone, has been used with three different meanings. It properly applies to the second limestone of the section found at Winterset, which limestone is called the Earlham.

A Pleistocene Section from Des Moines South to Allerton: JOHN L. TILTON.

Along the new railroad line from Des Moines to Allerton are fine exposures of the Pleistocene, photographs and descriptions of which should be preserved for reference since the relation of the deposits will very quickly become obscured. The exposures present strong evidence, supported elsewhere, that the so-called "gumbo" was deposited in the closing stages of the Kansan, and that it is but one form of a deposit for which collectively the term Dallas deposits is here suggested. Kansan drift and Des Moines shales are well exposed, but no Aftonian nor Nebraskan. Loess is found only in the northern portion of the area.

Mound and Mound Explorations in Allamakee County, Iowa: ELLISON ORR.

The paper covers in a general way the pre-

historic earthworks found in this country along the Mississippi and Oneota rivers. These earthworks consist of three types, the most common being the Circular Mound. Following that the Long Embankment, these latter sometimes having a length of upwards of four hundred feet, and where found on the bluff tops they uniformly follow the divides separating the gullies and ravines opening into the main river valley. Following these in frequency of occurrence are the Effigy Mounds. It is somewhat difficult to say what particular animal or bird these mounds are intended to represent, but there is quite a variety. Near McGregor is a group of three which are in a very fine state of preservation and were undoubtedly intended to represent the buffalo. Along the Oneota River, but not found on the Mississippi, are embankments in the form of a circle. Some of these are on the bluff tops and some on the river bottoms. It is more than likely that a part of them are the remains of camps fortified with palisades, and others may have been built for some ceremonial purpose. The circular mounds are probably mostly burial mounds, and probably of great age, as no skeletal remains are found in any of them, and there is also a great scarcity of flint or other implements or of pottery.

An Electrical Method of Measuring Certain Small Distances, and Some Interesting Results: F. C. Brown.

The Variation of the Resistance of Antimonite Cells with the Current Flowing, and the Probable Interpretation of this Variation: F. C. Brown.

The Change of Young's Modulus of a Soft Steel Wire with Electric Current and External Heating: H. L. Dodge.

Are the Photo-electric High Potentials Genuine: Paul H. Dike and F. R. York.

Some Dangers in Statistical Methods: Arthur G. Smith.

The Problem of the Vision of an Illuminated Surface: L. P. Sieg.

On the Existence of a Minimum Volume Solution: LeRoy D. Weld.

Phase Relations and Sound Beats when the Tones are Presented One to Each Ear: G. W. Stewart.

It has long been known that beats produced by two tones, presented one to each ear, are not quite like the beats produced when the same tones are presented to one of the ears. The experimental arrangement in this experiment was such that the frequency of beats could be changed, the tones being presented one to each ear, and the difference of phase could be observed optically. The observed results were as follows: When the beats were more frequent than one per second the beats were similar to ordinary beats except that there was no zero intensity minimum. This fact is not new. When the beats became less frequent than one per second, it was possible to persuade the hearer that there was a secondary maximum in the neighborhood of opposition in phase. When the beats became less frequent than one each five seconds the maximum intensity is difficult to select, the secondary maximum being more pronounced. Further, the secondary maximum seems to consist of two maxima, one just before and one just after opposition of phase. The tone at equality of phase is different in quality to that at the secondary maxima, the former being like the tone of the fork and the latter more of a noise. Some observers can not get the effect at all. When one of the tones is received through the teeth with the other received at one of the ears, there appears to be only one maximum, and that at opposition of phase. The proposed explanation involves a combination of a skull tone and an ear tone; but is too complicated to present in an abstract. The theory agrees with the experiments in a quantitative way if the velocity of sound in the skull is from two to three times that in air. The presence of a maximum at equality of phase does not seem to permit of ready explanation if the possibility of interference beyond the cochlea is rejected. The experiments were with forks of frequency 128. The theory should be tested under varying conditions.

The Use of the Rayleigh Disk in the Determination of Relative Sound Intensities: Harold Stiles.

During the summer of 1912 some experimental work was done at the State University of Iowa by G. W. Stewart and Harold Stiles partly intended to test the Rayleigh disk in the determination of relative sound intensities. The apparatus was mounted on the roof of the new physics building and results obtained experimentally were in close agreement with the theoretical values obtained by Stewart[3] for sound intensities in the neighborhood of a rigid sphere, the source of sound being on the sphere. Air currents, the inconstancy of the sound source and more particularly the absorption of energy by the Rayleigh

[3] *Phys. Rev.*, Vol. XXXVIII., No. 6, December, 1911.

disk tube are difficulties in the use of the apparatus.

A more extended account of the work may be found in *The Physical Review*, Vol. I., No. 4, 2d series, April, 1913.

An Experimental Investigation of the Relation between the Aperture of a Telescope and the Quality of the Image Obtained by It: FRED VORHIES.

Through research work carried on at the State University of Iowa, the conclusion has been drawn that astronomers are able to detect certain details upon the planet Mars. A twenty-four-inch telescope, as used by Professor Lowell, seems to be capable of giving these details as distinctly as can be obtained with a telescope of larger aperture.

Helpful and Harmful Iowa Birds: FRED BERNINGHAUSEN.

The Food Habits of the Skunk: FRANK C. PELLETT.

A Further Study of the Home Life of the Brown Thrasher, Toxostoma rufens (Linn.): IRA N. GABRIELSON.

The paper is a summary of the data obtained by watching from a blind the feeding of the young throughout one day. The total number of feedings was 169, of which 85 were by the male and 84 by the female. The following figures show the percentages of the various insects, etc., which comprised the food. Grasshoppers, 17.51 per cent.; May beetles, 29.95 per cent.; cutworms, 13.36 per cent.; cherries, 8.75 per cent. Miscellaneous insects made up the remainder. From the data at hand it seems that the thrashers are decidedly beneficial.

Nest Boxes for Woodpeckers: FRANK C. PELLETT.

A review of three years' successful experiments in attracting birds that supply no nesting material to artificial nesting sites. Three species not heretofore known to occupy boxes have reared their families in boxes of special pattern.

On Certain Features in the Anatomy of Siren lacertina: H. W. NORRIS.

Apropos of conflicting statements as to the presence of a maxilla and an operculare (splenial) in the skull of *Siren* the writer finds both present, but in a much reduced condition. Connected with the antorbital cartilage are two muscles (mm. retractor et levator antorbitalis) which with the cartilage form an apparatus for regulating the size of the choana. These two muscles have their homologues in *Amphiuma*. The ramus palatinus posterior facialis innervates a small vestigial muscle that has its origin on the fascia between the quadrate cartilage and the lateral edge of the parasphenoid bone, and its insertion on the lateral border of the ceratohyal cartilage.

Life History Notes on the Plum curculio in Iowa: R. L. WEBSTER.

A summary of insectary notes on the insect made in 1910 at Ames. These, taken with some field observations made by C. P. Gillette at Ames in 1889, give a fairly accurate account of the seasonal history of the insect in central Iowa.

Additional Mammal Notes: T. VAN HYNING.

The following species to the faunal list of Iowa have been added:

Firmly established: Canada porcupine, *Erethizon dorsatus* Linn.; Lemming mouse, Cooper's mouse, *Synaptomys cooperi* Baird; western harvest mouse, *Reithrodonomys dychei* Allen; pekan, fisher, *Mustella permantii* Erxleben. Now living in the state: American otter, *Lutra canadensis* Screber; American badger, *Taxidea americana* Boddaert; Canada lynx, *Lynx canadensis* Guldenstadt; American panther, cougar, puma, mountain lion, *Felis concolor* Linn. Additional to the catalogue: chickoree, small red squirrel, *Sciurus hudsonicus* Pallas; star-nosed mole, *Condylus cristata*.

The following have been listed for Iowa in *Bull. Field Col. Mus. Zool. Sur.*, Vol. 1, and may be looked for: *Peromyscus michiganensis* Audubon and Bachman, wood mouse; *Peromyscus leucopus* Rafinesque, wood mouse; *Tamias quadrivittatus neglectus* Allen, chipmunk; *Scalops argentatus* Audubon and Bachman, mole.

Color Inheritance in the Horse: E. N. WENTWORTH.

Factors are recognized in horse color. The terminology of Sturtevant is used in part. $C =$ red or yellow basic pigment, possibly partially diffuse; $H =$ Hurst's factor or black; $B =$ restriction factor producing bay. This is the principal new feature in the paper. B restricts black to the extremities, *i. e.*, eye, mane, tail, lower limbs, etc. The ability of the chestnut horse to carry this factor and in mating to blacks to produce bays explains a phenomenon that has been more or less of a stumbling block. Factors for gray pattern, roan pattern, dappling pattern, white stockings and blaze in face, and for piebald and skewbald markings are identified. Browns are distinguished from bays by the presence of the dappling factor. Tables showing results of over 12,000 matings are appended.

Some Factors Affecting Fetal Development: John M. Evvard.

The author showed that the size, weight, strength, vigor, character of coat, size of bone and general thrift of the newborn were markedly affected by the nutrition of the dam during the period of gestation. The specific food constituents which when added to corn produced positive results were protein and calcium, both of which (when added to corn) produced larger and heavier offspring than when corn alone was used. The importance of calcium was emphasized by calling attention to the fact that ordinary animals contain practically two thirds as much calcium as of nitrogen in their bodies. Using analytical figures as a basis, the investigation showed that the sow to produce a normal ideal litter would have to eat not less than 13 pounds of corn daily to secure enough calcium for said litter, and this on the assumption that all the calcium was perfectly utilized without any waste whatsoever, no allowance being made for the metabolic uses of the dam herself. The work was done upon sheep and swine. This direct quotation is of interest. "Realizing that the development of the organism may be hindered as early as the embryonic and uterine stages is quite suggestive of a rational diet during the entire period of gestation. Those pregnant animals which are forced to subsist upon grain diets are much more unfortunate than those which have their digestive systems so constituted as to avail themselves of considerable roughage, which, if they be legumes, are very advantageous in the production of vigorous newborn offspring. It is quite fortunate indeed that the mother is able to store in the bones and tissues of her body a considerable amount of material which will tide her over periods of scarcity and enable her to give birth to her young even though the essential constituents are lacking to a large extent in the pregnancy feed."

A Case of Urticaria Factitia: Walter S. Newell.

During a course of elementary experiments in the "tactual localization of a point" it was observed that in the case of Miss M., wherever the tactual stimulus was applied a round welt or wheal arose. These welts, which resembled bee stings, measured from 3 mm. to 5 mm. in diameter and varied in size with the instrument used in giving the tactual stimulus. The sharp corner of a card drawn lightly across the skin produced a line of bead-like welts. The welts appeared within three minutes after the stimulation and reached the maximum of vividness within five or ten minutes. They remained visible from half an hour to an hour and a half. Tests were tried with Miss M. at different hours of the day and at intervals of several days for a period covering eight weeks. Experiments showed that she exhibited this sensitiveness over widely distributed areas of the body, but no results could be obtained on the finger-tips or on other calloused portions. Most of the observations were made upon the forearm, both on the front and on the back of the arm. A careful study of Miss M.'s nervous organization, with the testimony of several of her instructors, supplied abundant evidence of her instability, and pointed toward a functional disorder caused by "nervous irritability, emotion and hysteria." A striking array of concrete instances of Miss M.'s nervous eccentricities could not be overlooked among the facts most significant in the diagnosis.

Several tests were made to determine whether the "autographisms" could be caused by suggestion or by any means other than actual contact. No results were obtained in this series of experiments, but this may be due to the subject's inability to fixate her attention for any length of time. The lightest contact was followed by the graphism, however, and according to Miss M.'s own testimony she has "known of this sensitiveness since childhood, but has never regarded it as anything unusual."

No attempt was made to use hypnotic suggestion as a means of inducing the graphisms. The subject's introspections are at times contradictory, although quite in accord with her own mental instability. This case throws a sidelight upon the prestige which in another age or in a different environment would be sufficient to lead to all degrees of religious extravagance or fanaticism.

Officers elected for the ensuing year are:

President—C. N. Kinney, Des Moines.

First Vice-president—H. S. Conard, Grinnell.

Second Vice-president—Henry Albert, Iowa City.

Secretary—L. S. Ross, Des Moines.

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Elective Members of the Executive Committee—E. N. Wentworth, Ames; E. J. Cable, Cedar Falls; A. G. Smith, Iowa City.

The next annual meeting will be held at the State Teachers College, Cedar Falls, Iowa.

L. S. Ross,
Secretary

Drake University,
Des Moines, Iowa